Roinn Tailte

(Department of Lands)

FO-ROINN IASCAIGH

(Fisheries Division)

REPORT

ON THE

SEA AND INLAND FISHERIES

FOR THE YEAR

1956,

incorporating Statistics of the Capture of Salmon, Sea Trout and Eels, and certain scientific papers relating to fisheries.

DUBLIN:
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NOTE :—Sea fish are divided into two categories, pelagic and demersal. The term " pelagic " (Greek : " pelagos ", the sea) is applied to those fish which usually swim at or near the surface of the water. The main varieties of pelagic fish landed are herrings, mackerel and sprats. The term " demersal " (Latin : " Demergere ", to plunge down) is applied to those fish which live during adult life at or near the sea bottom. The chief species landed are turbot, brill, soles, plaice, cod, haddock, hake, ling, whiting, conger eel and ray (skate). Shellfish consist of two classes, viz., molluscs, of which the main varieties gathered are oysters, mussels, escallops, periwinkles and cockles, and crustaceans—lobsters, crawfish, crabs, shrimps and prawns.

REPORT

OF THE

MINISTER FOR LANDS

ON THE

SEA AND INLAND FISHERIES

FOR THE YEAR

1956.

PART I.

SEA FISHERIES.

The overall picture of the Irish sea-fishing industry as presented in this report is one of continued expansion and development. Landings from all the various operations engaged in by fishermen showed satisfactory improvement on the corresponding results for 1955 and, even though the 1955 average unit prices were not maintained for a few varieties, the fishermen had the benefit both of a higher turnover and an increased average price all over. For the first time in the history of the State, the total value of all sea-fish landed exceeded one million pounds, the actual figure being £1,020,794, representing an increase of 15.7% or £138,496 over the total for 1955. The catch of demersal and pelagic fish increased in quantity and value by 24·3% and 7·9% respectively compared with 1955, while the value of the shellfish landings showed improvement to the extent of 14%. The following table gives the quantity and value of sea-fish (excluding shellfish) landed annually during the past ten years. Shellfish has been omitted as the unit of measure used in the shellfish industry varies according to the different species and thus an overall quantitative total is not readily assessable.

TABLE 1.

Year		Cwt.	£
1956	...	377,367	787,160
1955	...	303,519	686,195
1954	...	254,714	635,802
1953	...	222,516	545,105
1952	...	203,000	478,774
1951	...	187,645	431,875
1950	...	214,236	442,309
1949	...	234,674	507,342
1948	...	385,243	595,647
1947	...	316,438	547,185

In Appendices 1 and 2 will be found a breakdown of the above figures into the different varieties as well as the average unit value of each category to the fisherman. During 1956 fishing operations were not seriously hampered by any prolonged adverse weather, though at infrequent intervals unfavourable conditions in some localities affected overall production. Partial scarcities resulting from such circumstances, together with occasional seasonal shortages in certain kinds of both demersal and pelagic fish, made imports of fresh and frozen fish on a small scale necessary to meet consumer demand. The total quantity of such imports amounted to 5,785 cwts. valued at £17,265. The ports with the highest value of fish landed were Killybegs, Castletownbere, Dingle, Dunmore East, Howth, Kilmore Quay and Dublin. The rapid development in recent years of Castletownbere into one of the major landing places in the country brought the port to second place in the list in 1956, surpassed only by Killybegs where the fleet is numerically superior.

DEMERSAL FISHERY.—Due in no small degree to the increase in the number of first-class motor boats operating on the coast, is the sustained improvement in the demersal fishery which in 1956 brought £67,457 more to the fishermen than the £593,190 they shared in 1955. The quantitative increase was 31,572 cwts. making the total landing 225,488 cwts. Of the different varieties, the weight of haddock, whiting and ray landed each showed substantial increases and catches of brill, turbot and plaice also improved but to a lesser extent. In the case of cod, conger, hake and ling there was a decline in production but, with the exception of cod, these varieties are not largely represented in the total take. The average unit price of each variety save cod, plaice and whiting increased in 1956. In cod and plaice the drop was very small being 1/6d. and 1/4d. per cwt. respectively. The drop of 2/10d. per cwt. in the average price for whiting may have been accounted for by bulk buying for industrial purposes of large quantities of small whiting which

without such an outlet would not have found a ready sale. The quantity, value, and average unit price of demersal fish landed each year for the past 10 years are set out in the following table.

TABLE 2.

Year		Cwt.	£	Average value per cwt.
				s. d.
1956	...	225,488	660,647	58 7
1955	...	193,916	593,190	61 2
1954	...	169,926	540,690	63 7
1953	...	147,757	451,901	61 2
1952	...	134,841	397,276	58 11
1951	...	119,055	354,536	59 7
1950	...	119,645	364,702	61 0
1949	...	151,537	416,275	54 11
1948	...	152,567	423,436	55 6
1947	...	143,677	397,008	55 1

PELAGIC FISHERY.—*Herrings:* A substantial increase in the landings of herrings in 1956 contributed largely to the general improvement in the total value of sea-fish landed. The total catch amounted to 137,849 cwts. which realized £101,608 on first hand sale. These totals exceeded the 1955 figures by 42·7% and 37·7% respectively. The average unit value, however, decreased slightly, *i.e.* by 6d. per cwt., from 15/3d. per cwt. in 1955, but in contrast with the quantitative increase, this drop was insignificant. Below are set out details of the quantity and value of the herring catch each year since 1947 and in Appendix 4 will be found the names of the principal landing centres.

TABLE 3.

Year		Cwt.	£	Average value per cwt.
				s. d.
1956	...	137,849	101,608	14 9
1955	...	96,560	73,782	15 3
1954	...	68,322	72,848	21 4
1953	...	58,981	70,066	23 9
1952	...	54,947	60,451	22 0
1951	...	49,823	56,830	22 10
1950	...	67,840	55,438	16 4
1949	...	45,300	49,438	21 10
1948	...	73,050	73,828	20 3
1947	...	124,918	111,284	17 10

Dunmore East in Co. Waterford, as in 1955, recorded the largest volume of herrings, its total landing of 60,400 cwts.

exceeding by 170% the previous year's total. The sale of the catch brought £37,151 to the fishermen. The chief factors which contributed to this continued expansion were, firstly, the greater participation by Dutch buyers in the trade; secondly, the satisfactory demand in Great Britain which lasted until the first arrivals of Norwegian herring and thirdly, the existence of a speedy and efficient transport service from port of landing to the British market. Home consumption of Dunmore herring was light in comparison with exports but kipperers, both locally and in Dublin, handled a fair share of the total catch.

The industry is fortunate in that the two major herring fishings engaged in by Irish vessels occur at a time when herring fishing along the British and European North Sea coast is slack. The North Coast herring fishing in 1956 amounted to 62,782 cwts. an increase of 20% over the 1955 figure. Of this quantity Killybegs landed 34,800 cwts. while Gortnasate and Bunbeg accounted for 13,300 cwts. and 10,400 cwts. respectively. Landings at Killybegs commenced in September when good quality fulls and large fulls met with brisk demand for freshing, curing and kippering. Later the quality of the catches deteriorated and large landings of spents were cleared very satisfactorily. All Killybegs landings were made by boats using herring ring nets which were also responsible for the larger share of the Gortnasate landings. Bunbeg and Burtonport boats continued to use drift nets throughout. The quality of the herring at these three ports was predominantly large full. One Irish firm brine cured the equivalent of 2,100 whole barrels of the Bunbeg, Burtonport and Gortnasate landings and disposed of the lot to Eastern European buyers, together with a small parcel of herrings cured earlier from the September Killybegs landings. For the second year in succession a British firm operated at Burtonport where they packed 1,500 barrels of marinated herring fillets for English and Continental markets. An Bórd Iascaigh Mhara, working at Killybegs, packed 438 barrels of filleted herring in brine and klondyked almost 1,000 cran, both for direct shipment to Germany. In addition the Board produced approximately 28,000 stones of kippers and kipper fillets in their Killybegs plant. Kipperers in Annalong, Howth and Dublin also helped to effect satisfactory clearance while the cross-channel freshing trade maintained a brisk demand for the better quality product.

Landings of herring on the East and West Coasts were smaller than those of 1955. On the East Coast 5,937 cwts. represented the total catch, landed mainly at Carlingford, Clogherhead and Arklow. Keel and Achill were the major contributors to the 2,171 cwt. total of the West Coast catch.

MACKEREL.—A slight improvement of 2,287 cwts. over 1955 total brought the 1956 catch figure to 13,850 cwts. the value of which was £24,815 or £5,900 more than the previous year.

The average unit value improved by 3/1d. to 35/10d. per cwt. Mackerel fishing is engaged in all along the South, West and North Coasts but is not pursued by the larger type boats except at Baltimore in Co. Cork where 4,273 cwts., or approximately one-third of the total, was landed. Cahirciveen and Dingle in Co. Kerry, Lackan in Co. Mayo and Malinbeg in Co. Donegal were the next in importance as mackerel centres. Figures of quantity, value and average unit price for the past 10 years are set out below :—

TABLE 4.

Year	Cwt.	£	Average value per cwt.
			s. d.
1956 ...	13,850	24,815	35 10
1955 ...	11,563	18,913	32 9
1954 ...	14,766	21,967	29 9
1953 ...	15,374	22,976	29 11
1952 ...	13,018	20,967	32 3
1951 ...	17,017	19,959	23 5
1950 ...	19,838	20,399	20 7
1949 ...	27,220	38,399	28 3
1948 ...	150,076	95,673	12 9
1947 ...	38,260	36,011	18 10

SHELLFISH.—The picture provided by the shellfish section of the industry is an encouraging one of continued expansion. With a total landed value in 1956 of almost a quarter of a million pounds the shellfish trade merits close attention by everybody concerned to the maintenance of the highest standards of quality so that the steadily growing export demand for our products can be met and still further enlarged.

An examination of the figures for total value shows an increase of approximately 14% from £196,103 in 1955 to £233,634 in 1956. Oysters alone of the principal varieties fished showed a slight drop in landings. An insignificant decrease will also be noted in the total of "other varieties". Lobster and crawfish fishing and periwinkle picking on a more extensive scale to satisfy increasing Continental demand contributed largely to the overall increase. The two first mentioned varieties were in evidence from early in April to December, and along the East Coast the fishing was continuous over the whole year. Periwinkle gathering also developed into an all year round activity along the well stocked areas on the South and West Coasts. These more intensive fishing operations were largely brought about by a growing Continental demand. The various varieties were to a large extent exported as usual to Great Britain. Out of a global export value of £311,525, the Continental markets took consignments to the value of £194,768, France being the biggest customer in this group. Norway lobster fishing at East

Coast ports, particularly at Clogherhead, proved to be a satisfactory occupation for fishermen in that area during what would otherwise have been a somewhat slack fishing period. The annual value of shellfish landings for the past 10 years is shown below :—

TABLE 5.

	£
1956 ...	233,634
1955 ...	196,103
1954 ...	154,525
1953 ...	142,554
1952 ...	124,196
1951 ...	93,604
1950 ...	87,119
1949 ...	108,487
1948 ...	100,466
1947 ...	106,563

PERSONNEL AND VESSELS.—The revision in the compilation of statistics in this regard introduced in 1955, to which reference was made in the Report for that year, was completed in 1956. The resultant drop, particularly in the numbers of men classed as " partially engaged " and of boats in the smaller categories, *i.e.* sail boats under 10 tons and row boats, reads large but does not connote any reduction of productive capacity. The reason for this is that the contribution to the catch for marketing made by many of those formerly included in the " partially engaged " class is of little consequence as their activities extend to little more than subsistence fishing.

A very slight reduction, 46, from the 1955 figure of 1,630 is noted in the number of men solely engaged. This apparent decline is attributable entirely to the use of the new method of compiling the returns. The drop of 1,132 in the partially engaged category is mainly due to revised enumeration. Emigration from the more congested areas of the South and West Coasts has, however, also contributed to this result.

The number of motor boats of 15 tons and over engaged in fishing in 1956 exceeded by seven the 1955 total though a number of the older vessels in this category went out of service during the year.

Details of personnel engaged in the industry and the numbers, type and distribution of vessels used are given in Appendix 6.

AN BORD IASCAIGH MHARA.—The Board's Fourth Annual Report (including financial accounts) which was published during the year, covered the twelve months ended 31st March, 1956. The following are the major points dealt with in the report.

In the course of the year nine 50 ft. boats were completed in the Board's yards and two others of 45 ft. and 55 ft. respectively were supplied to the Board's order by other yards. Construction in progress as at 31st March, 1956, comprised eight boats by the Board and seven to their order by other builders. The Board issued on hire-purchase during the period, eleven newly-constructed boats, in addition to which four second-hand boats were also made available and seven boats were re-engined. Issues for the year of boats and gear on hire-purchase, credit sale or for cash were valued at £171,862 in all. The number of motor fishing vessels, the subject of hire-purchase transactions at 31st March, 1956, was ninety-five, valued at £390,000 approximately. In accordance with the scheme for the provision of fishing boats in the Fior-Ghaeltacht, the Board had laid down at its own yards two 56 ft. vessels and had placed an outside order for two more, to a similar design.

The quantity and value of fresh sea-fish (excluding shellfish and imported white fish) handled by the Board in the period under review was 157,528 cwt. valued at £508,233 as compared with 107,983 cwt. valued at £414,006 in the previous corresponding period.

A loss of £11,220 resulted from the operation of the Board's three offshore vessels in contrast with a loss of £10,240 in the preceding year. The catch was maintained at slightly above 1954/55 level despite mishaps bringing about a total loss of 36 weeks fishing time. The trainee scheme for prospective skippers and second-hands on board these vessels remained a feature of their operation.

Production of frozen fish, kippers, fish meal and fish oil was continued at the Killybegs factory. A loss of £5,135 on the year's working was sustained, compared with £4,531 for the previous year. The fish meal plant is on a pilot scale only and much of the work engaged in at the factory was of an experimental and development kind.

In pursuance of a comprehensive long-term programme of shore development works plans were prepared for work at seven sites on projects which included ice-manufacture, fish handling, processing and freezing installations and cold storage facilities. As at 31st March, 1956, work was in progress at two sites and tenders had been accepted in respect of two other undertakings.

AN COMHLACHAS IASCAIGH MHARA.—The affairs of this Association reached an impasse in the course of the year and its functions were in abeyance at the close of the period.

SEA FISHERIES PROTECTION.—The protection of the exclusive fishery limits is in the charge of the naval service of the Department of Defence which conducted regular patrols over the areas throughout the year under review. No infringement of the limits was detected. The Gárda Síochána again lent their

assistance in the enforcement of fishery protection laws generally. Inspections of fish and fishing nets also continued to be made in relation to the regulations prescribing measurements for fish and sizes of mesh. Some irregularities were detected, resulting in prosecution or the issue of strict warnings according to the circumstances of each particular case.

SCIENTIFIC INVESTIGATIONS.—Experimental crab fishing was carried out at Glandore, Co. Cork, in April, at Dunmore East, Co. Waterford, in June, at Carna, Co. Galway, in July and at Downings, Co. Donegal in August. The experiments at Carna gave the most promising results ; a considerable stock of crabs suitable for commercial exploitation being found to exist in that area. Experimental fishing for prawns (*Leander serratus*) was carried out at Bertaboy Bay, Co. Galway, in July and at Helvick in Co. Waterford during August. Small stocks of prawns were found in Bertaboy Bay and commercial quantities at Helvick. These experiments were a continuation of those commenced in 1955. Experimental fishing for Norway lobsters (*Nephrops norvegicus*) was carried out in Bantry Bay, Co. Cork, in May and off Helvick, Co. Waterford in August. Large stocks of Norway lobsters were found in Bantry Bay but off Helvick the catch was generally poor, suggesting that it might not prove economic to fish for Norway lobsters in this area. In November and December the escallop beds off the north Galway Bay coast were studied closely and a continuation of such work decided upon. Experimental work in connection with the possible rehabilitation of an oyster bed in Clew Bay was continued but, while some evidence was forthcoming indicating that the planted oysters had spawned in limited degree, no firm conclusions could be drawn by the end of the year and the work is to be continued.

As in previous years, surface temperatures of sea water on the Conigsbeg lightship were taken twice daily throughout the year and data so obtained has been forwarded to the International Council for the Exploration of the Sea for inclusion in the charts prepared by that body.

During the year two species of rare fishes were obtained. The first occurred during experimental fishing for Norway lobsters from the 20th to the 25th August between Helvick and Mine Head when six specimens of the red band or red snake fish (*Cepola rubescens*) were identified. This species had been previously identified on a number of occasions from the Irish coasts but only as single specimens. The other rare capture was a specimen of the dusky perch (*Epinephelus gigas*) which was taken by a seine net from a motor trawler when working eight miles east north east of Howth on the 10th December. This species had only been recorded once previously from Irish waters. The specimens were deposited in the National Museum, Dublin.

INTERNATIONAL CONFERENCE :—

(1) International Council for the Exploration of the Sea.—The Inspector and Scientific Adviser attended the annual conference of the International Council for the Exploration of the Sea at Copenhagen from 1st to 10th October. Proceedings of the Salmon and Trout, Atlantic Slope, Hydrographical and Statistical Committees were of particular interest to this country. An account of salmon tagging along Donegal Coast was read to the Salmon and Trout Committee by this Department's representative who was re-elected Chairman of that Committee for the ensuing year.

(2) Permanent Commission of the International Fisheries Convention of 1946.—The Permanent Commission held one meeting in London in September and this was attended by officials of the Fisheries Branch who also took part in two informal meetings in London in May and September of representatives of the countries adhering to the 1946 Convention to discuss suggestions for revision of the Convention. It was not found possible to agree on all points at these informal discussions and it is expected that a further meeting will be held during 1957.

(3) Association of British Zoologists.—The Inspector and Scientific Adviser attended the annual meeting of this Association which had on its Agenda the discussion of modern methods of research.

(4) Fisheries Mission to West Africa.—The services of the Inspector and Scientific Adviser were made available on loan for participation in a fisheries mission organised by the British Secretary of State for the Colonies to advise as to the future of the fisheries research in the four West African territories, namely, Nigeria, the Gold Coast (now Ghana), Sierra Leone and Gambia.

MARINE WORKS.—As in former years, schemes for the improvement of landing facilities for fishermen about the coastline were advanced by the Department in collaboration with the Office of Public Works and other Government Departments and Local Authorities.

LEGISLATION.—The Sea Fisheries (Amendment) Act, 1956 (No. 30 of 1956) increased to £1,000,000 the previous limit of £500,000 of advances that may be made out of the Central Fund to An Bórd Iascaigh Mhara.

PART II.

INLAND FISHERIES.

EXTENT OF FISHERY DISTRICTS AND NAMES OF THE PRINCIPAL RIVERS IN EACH DISTRICT.

District	Extent of District	Principal Rivers
No. 1 Dublin	Most easterly point on Red Island, Skerries, to Wicklow Head.	Liffey Vartry.
No. 2 Wexford	Wicklow Head to Kiln Bay, east of Bannow Bay, Co. Wexford.	Slaney Avoca
No. 3 Waterford	Kiln Bay, east of Bannow Bay to Helvick Head, Co. Waterford.	Suir Barrow Nore.
No. 4 Lismore	Helvick Head to Ballycotton Pier, Co. Cork.	Blackwater, Funshion, Bride, Awbeg.
No. 5 Cork	Ballycotton Pier to Crow Head, Co. Cork.	Lee, Owenboy, Bandon, Argideen, Ilen, Mealagh, Owvane, Coomhola, Glengarriff, Adrigole.
No. 7 Kerry	Crow Head, Co. Cork, to Kerry Head, Co. Kerry.	Roughty, Sheen, Finnihy, Blackwater, Sneem, Laune, Flesk, Maine, Caragh, Currane, Cummeragh, Inny.
No. 8 Limerick	Kerry Head, Co. Kerry, to Hag's Head, Co. Clare.	Shannon, Deel, Fergus, Mulcair, Little and Upper Brosna, Inny, Maigue, Feale.
No. 9[1] Galway	Hag's Head to the sea point of the boundary between the townlands of Keeraunagark South and Banraghbaun South, Co. Galway.	Corrib, Claregalway.
No. 9[2] Connemara	The sea point of the boundary between the townlands of Keeraunagark South and Banraghbaun South, Co. Galway to Slyne Head Co. Galway.	Ballinahinch, Recess, Cashla, Owengowla, Invermore, Inverbeg, Screebe, Furnace.
No. 10[1] Ballinakill	Slyne Head to Pigeon Point, Westport Bay, Co. Mayo.	Culfin, Errif, Bundorragha, Dawros, Carrowniskey, Bunowen (Louisburgh).
No. 10[2] Bangor	Pigeon Point to Benwee Head, Co. Mayo.	Newport, Burrishoole, Owenduff, Owengarve, Owenmore, Glenamoy.

District	Extent of District	Principal Rivers
No. 11 Ballina	Benwee Head to Coonamore Point, Co. Sligo.	Moy, Cloonagimmore (Palmerston), Easkey.
No. 12 Sligo	Coonamore Point to Carrickgarve, Co. Sligo.	Ballisodare, Garavogue (Sligo), Bonet, Drumcliff.
No. 13 Ballyshannon	Carrickgarve to Rossan Point, Co. Donegal.	Erne, Bundrowes, Bunduff, Eske, Eaney Water, Oily, Glen.
No. 14[1] Letterkenny	Rossan Point to Malin Head, Co. Donegal.	Owenea, Gweebarra, Gweedore (Crolly), Clady, Lackagh, Lennon, Crana.
No. 17[2] Dundalk	Carlingford Lough to Clogher Head, Co. Louth.	Fane, Dee, Glyde.
No. 17[1] Drogheda	Clogher Head to the most easterly point on Red Island, Skerries, Co. Dublin.	Boyne, Blackwater, Deel.

NOTE.—The area comprised in the former No. 14[2] or Moville District was, by the Foyle Fisheries Act, 1952, incorporated in the Foyle Area which is administered by the Foyle Fisheries Commission.

INLAND FISHERIES.

Every person who is in possession of a licence to fish for salmon, sea trout and eels is required to furnish details of his catches in the manner prescribed by the Statistics (Salmon, Sea Trout and Eels) (No. 2) Order, 1945. The total catch of salmon by all methods in 1956 as so returned was 1,443,340 lb. compared with 1,261,402 lb. in the preceding year. The 1956 catch was valued at £415,931 when landed compared with £363,788 for the preceding year. The catch of sea trout amounted to 93,152 lb. valued at £15,136 compared with 73,201 lb. valued at £10,824 for the preceding year. The total quantities and value of salmon and sea trout taken in the years 1954, 1955 and 1956 are shown in Appendix 9. The catch of salmon and sea trout made in the former Moville Fishery District now incorporated in the Foyle Conservancy Area is given in the section of this report relating to the Foyle Fisheries Commission.

The 1956 season was characterised by fairly heavy rain which continued throughout most of the season. Thus conditions generally were not favourable to netting but were favourable for most of the season for angling as satisfactory water conditions generally prevailed. The runs of spring fish were again poor, even compared with those of 1955 in which year, as reported previously, all groups of spring fish were scarce. As in the previous four seasons the grilse did not run in force until the middle of July. The grilse runs appear to have been very much larger than those of the past few years but, because of the continuous rainy weather, conditions were unsuitable for netting, and in consequence, the catches were poorer than they would have been in a normal season. This is confirmed by the fact that in the rivers normally holding grilse, the spawning stocks appear to have been exceedingly large.

Particulars of the catches of salmon made in each district for the years 1954, 1955 and 1956 are given in Appendices 10 and 14. The catch of salmon for 1956 was distributed as to the various methods of capture as follows :—

Draft nets	49·9%
Rod and line	18·3%
Drift nets	17·4%
Stake nets and other commercial methods	14·4%

As mentioned in the report for 1955 the proportion of fish taken on rod and line has shown a steady increase in recent years. The number of fish taken by this method in 1956 was the highest on record at 35,757 fish. The weight of the rod caught fish was, however, less than for 1954, and the explanation of this is that in 1956 very large numbers of grilse were taken on rod and line owing to favourable conditions, not only for angling

but also for the entrance of this age group to the freshwater portions of most rivers. This is reflected in the average weight of fish taken on rod and line, namely, 7·4 lb. in 1956 compared with 8·6 lb. in 1955 and 8·8 lb. in 1954.

The total number of rod licences (excluding endorsements) issued in 1956 was 7,495, an increase of 891 licences over the comparable figures for 1955. The average catch of salmon per rod was 4·8 fish weighing 35·3 lb. and valued by their captors at approximately £10 5s. 0d. The average number of salmon taken per rod showed a slight increase over that for 1955 but the average weight was down by approximately 2 lb. and the value by about 4/-. The highest average weight of salmon taken on rod and line (12·3 lb.) was again from the Drogheda district in which the bulk of the catch is of the heavier spring fish. The lowest average weight (6·3 lb.) was from the Ballina district in which the catch consists almost entirely of grilse.

The catch of sea trout showed a marked increase over that of previous years, the catch both by rod and line and by commercial methods showing an increase over that of the previous seasons. The sea trout catch was distributed as follows :—

Rod and line	60·3%
Draft nets	36·1%
Other commercial methods ...	3·6%

The average catch of sea trout per rod was 7·7 fish and 7·5 lb. valued about 23/–. More than 10 fish per licence were landed in the Connemara (27·0), Bangor (17·9), Ballinakill (16·3), Kerry (11·6), and Cork (10·1) Fishery Districts.

The drift net fishery off the coast of Donegal and the northern coast of Co. Mayo, as mentioned in previous reports, depends for its success on the runs of grilse and suitable weather conditions. During the season weather conditions were generally unfavourable for this form of fishing and in addition the run of grilse did not materialise until late. During the peak of the grilse runs, however, conditions proved more favourable and with large runs of fish, the total catch showed considerable improvement over that of the previous season despite a slight reduction in the number of boats fishing.

The migration of smolts to the sea in 1956 was reported generally to be larger than usual in most districts. The spawning season of 1956/57 was also reported to have been exceedingly good with little disturbance of spawning fish owing to the continuous high water. During the year there was a notable absence of furunculosis and in one place where, when fish are held up in periods of drought and warm weather it has appeared regularly in the past ten years or so, it was not recorded during 1956.

The yield of the eel fisheries at 180,923 lb., despite poor conditions for trapping eels in some rivers towards the end of the season, was only slightly less than in 1955 but the value was

considerably up at £21,836 compared with the previous year at £19,433. Appendix 12 gives details of the catches of eels as to the quantity and value for each fishery district in which eel fishing was practised in the years 1954, 1955 and 1956.

BOARDS OF CONSERVATORS.—The receipts and expenditure of Boards of Conservators during the fishery years ended 30th September, 1956, and 30th September, 1955, were :—

RECEIPTS :	1956	1955
	£	£
Licence Duty	18,279	17,044
Fishery Rates	31,597	31,086
Subscriptions	782	257
Grant to Limerick Board by Electricity Supply Board ...	—	3,000
Exchequer Grants	13,709	13,397
Miscellaneous Receipts ...	1,957	8,757
	£66,324	£73,541
EXPENDITURE :		
Salaries, etc.	11,007	11,818
Travel, etc.	15,310	11,684
Protection of Rivers	37,996	37,257
Law Costs	1,956	1,992
	£66,269	£62,751

The foregoing summary of receipts and expenditure does not include sums received by way of special local licence duty surrendered to the Exchequer in pursuance of Section 13 of the Fisheries (Tidal Waters) Act, 1934. Details of the financial receipts and expenditure of each Board are given in Appendix 16.

EMPLOYMENT IN THE INDUSTRY.—Exclusive of persons employed in the marketing and transport of fish a total of 5,695 persons found either whole-time or part-time employment in inland fisheries during the year. This figure includes some 3,725 persons engaged in netting for salmon under common law right and 1,089 employed by Boards of Conservators on protection of fisheries over the open and close seasons, the remainder being employed by proprietors of commercial salmon fisheries on private fisheries or by angling associations.

INSTRUMENTS OF CAPTURE.—The total number of fishing licences of all kinds issued during the year was 10,135, representing an increase of 1,108 on the total for 1955. The totals in recent years were 1955, 9,027 ; 1954, 8,690 ; 1953, 8,444 ; 1952, 7,990 ; 1951, 7,563.

The numbers of the various classes of licences issued in each fishery district during the year and the rates of licence duty are given in Appendices 17 and 18 respectively.

SALMON EXPORTS.—The quantity of salmon exported in 1956 was 13,564 cwt. valued at £557,016 as compared with 11,135 cwt. valued at £451,874 in 1955. These figures include salmon landed in Co. Donegal from waters in the area administered by the Foyle Fisheries Commission.

The 1956 figures show an increase of 2,429 cwt. in quantity and £105,142 in value on the 1955 figures. The average export price per cwt. at £41 1s. 3d. obtained in 1956 was higher than in 1955 when the figure was £40 11s. 8d.

The number of salmon exporters licensed under the Agricultural and Fishery Products (Regulation of Export) Act, 1947 (Export of Salmon) Order, 1954 (S.I. No. 275 of 1954) was 93. Of the total quantity of salmon exported, 12,431 cwt. went to markets in Great Britain and 769 cwt. to France. The balance went to the Six Counties, Germany and Switzerland.

ARTIFICIAL PROPAGATION OF SALMON AND TROUT.—During the 1955/56 spawning season conditions for the capture of parent fish were satisfactory at most centres and in consequence the output of salmon, sea trout and brown trout showed an improvement on that of the previous year. A total of 1,042,000 ova of salmon was distributed from hatcheries controlled or subsidised by the State. Sea trout ova produced at the State hatchery, Glenties, numbered approximately 145,000 and the bulk was distributed to other hatcheries for planting out in local waters.

The hatcheries at Loughs Owel and Ennell, operated by the Department in conjunction with the local anglers' associations, yielded 1,011,000 brown trout ova, of which 521,000 were distributed to angling associations and others, the balance (490,000) being hatched at Loughs Owel and Ennell and the resultant fry placed in local waters. Brown trout ova numbering 450,000 were imported from Great Britain, including 350,000 by the Inland Fisheries Trust Incorporated. Ova of rainbow trout (50,000) were also imported from Great Britain by the Inland Fisheries Trust Incorporated and hatched out at the Roscrea hatchery. A proportion of these fish was planted out as fingerlings in waters selected by the Trust for experimental stocking and the remainder is being reared for table use. Further reference is made to the fish farm established by the Inland Fisheries Trust Incorporated in a later paragraph. An experimental trout farm was established by the North Kildare Anglers' Association at Rosetown near Newbridge, Co. Kildare

and 25,000 brown trout ova were hatched and reared to the fingerling stage before being released into the River Liffey. Details of the fry produced at the hatcheries and hatching stations, apart from the fish farms mentioned, are given in Appendix 21.

SCIENTIFIC INVESTIGATIONS.—Investigations which commenced in 1948 into the movements of salmon in the sea around Ireland were continued during the year. One hundred and seventy-eight salmon taken by drift nets off the north coast of Donegal by boats fishing out of Downings were tagged and released. In all 23 tags were recovered during 1956 and a single tag just after the close of the year. Recoveries in 1956 were made in the Rivers Foyle (1), Owenea (1), Erne (1), Moy (12), Culfin (1), Corrib (1), Glengarriff (1) and Feale (1) as well as in the open sea off Malin Head (1), Kilcar, Co. Donegal (1), and Streedagh, Co. Sligo (1). A single fish was retaken in the river Stinclar in Ayrshire in the south west of Scotland. The single recovery at the beginning of 1957 was made in the Bundrowes River when the fish was a kelt. These results are in general similar to those obtained in previous years. A preliminary report on the results of tagging of salmon taken by drift nets in this area was read to the Salmon and Trout Committee of the International Council for the Exploration of the Sea at its Annual Meeting in Copenhagen in October, 1956, by the Inspector and Scientific Adviser. A report by an Assistant Inspector on results of tagging experiments carried out at Rath, Co. Kerry, in earlier years was completed and was accepted for publication in the *Proceedings of the Royal Irish Academy*.

Tagging of kelts of salmon and sea trout was again carried out at five hatcheries as follows:—Ballisodare, Co. Sligo; Banteer, Co. Cork; Glenties, Co. Donegal; Lismore, Co. Waterford, and Treanlaur, Co. Mayo. In all 876 salmon and 230 sea trout were tagged and released. Recaptures totalling 21, mostly of kelts tagged in earlier years, were made during the year. Nine smolt tags were also recovered from fish taken in the River Shannon which had been tagged as smolts in 1954 at Ardnacrusha Power Station.

Experiments on the movements of salmon in the estuary of the River Shannon were continued during 1956. In all 205 fish were tagged and 63 recoveries of tags were made. A report on these experiments was in preparation at the close of the period under review. In the months of November and December salmon caught in the counting trap at Annacotty, Co. Limerick, on the Mulcair River, a tributary of the Shannon, were tagged and released. A total of 235 fish were so tagged and two recoveries from dead kelts were made before the end of the year. Investigations into the movements of salmon into the Rivers Cashen and Ilen were carried out in the months of March and April. One hundred fish were tagged and released in the tidal waters

of the River Cashen and 29 recoveries of tags were made, the majority being retaken within one month of tagging. In the tidal waters of the Ilen 25 fish were tagged and five were recaptured, together with one fish tagged in the previous year. These experiments indicate that the passage of fish through the tidal waters of the Rivers Shannon, Cashen and Ilen is comparatively rapid and many fish appear to move from the open sea into the freshwater portions of these rivers in a few days.

Scales and relevant data from a number of other rivers were collected during the year and these were in the course of examination at the close of the period under review.

Officers of the Department again collaborated with officers of the Ministry of Commerce, Belfast, in a research programme on salmon and sea trout of the River Foyle. In all 736 salmon and grilse were tagged in Rosses Bay in the tidal waters of the River Foyle and up to the 30th November, 1956, 292 tags had been recovered. A report on this investigation was prepared as an Appendix to the Fifth Report of the Foyle Fisheries Commission. Collections of scales and data made in 1955 from salmon taken in the Foyle Fisheries Commission's fishery were examined and a report prepared for inclusion in the Fifth Report of the Foyle Fisheries Commission. Investigations were started into the runs of " black school " fish which are reported to make their appearance in this river towards the end of the fishing season.

A collection of sets of scales and data of sea trout from the Argideen River was kindly made available during the year by local anglers and examination of this material was started at the close of the period under review. A small collection of sets of scales and data of sea trout from the River Ilen, made by the late William Birtwistle, one time Director of Fisheries in Malaya, was kindly given to the Department by Mr. Birtwistle's widow. This material was worked out and a report by the Inspector and Scientific Adviser was accepted for publication in the Salmon and Trout Magazine.

The material from Lough Glore collected in connection with the coarse fish eradication scheme was worked out by the Technical Assistant who also worked out some material collected over a number of years relating to the dace and roach of the Blackwater. The latter two species were originally introduced into the Blackwater about the year 1889 and since that time they have increased steadily in numbers so that large stocks are now present in the Blackwater and its major tributaries.

At the end of the year experiments were conducted with a view to ascertaining the reasons for the high rate of mortality sometimes experienced at the Mallow hatchery operated by the Blackwater Hatchery Committee.

During the year a number of fish were received for identification including a tench from the lakes of Killarney, a lacustrine form of the twaite shad from the same lake and some specimens of

the allis shad (*Alosa alosa Cuv.*) from the River Ilen near Skibbereen. The allis shad has only been identified previously from the River Erne, Inver Bay, Co. Donegal, and Donaghadee, Co. Down.

One of the Assistant Inspectors who is a member of the Council of the Inland Fisheries Trust Incorporated, continued to investigate the material collected by the Trust in particular the stomach contents, age and growth of pike taken in coarse fish netting operations. This investigation has made it clear that the pike is one of the greatest menaces which Irish salmon and trout fisheries have to face.

The Inspector and Scientific Adviser was elected Chairman of the Irish Specimen Fish Committee which was established at the end of 1955.

OFFENCES AGAINST THE FISHERY LAWS.—The number of prosecutions instituted during 1956 was 266 as compared with 171 in 1955. The Gárda Síochána and angling associations continued to assist Boards of Conservators in the protection of inland fisheries during the year.

FOYLE FISHERIES COMMISSION.—This Commission, which consists of two members nominated by the Minister for Agriculture, Dublin, and two by the Ministry of Commerce, Belfast, was established under the Foyle Fisheries Act, 1952, and entrusted with the management of the tidal waters of the River Foyle and the conservation and protection of the fisheries in the Foyle Area. The Commission, with one change in personnel during the year, continued to discharge those duties in 1956.

The total catch of salmon and sea trout in the Area in 1956, as published in the fifth Annual Report of the Commission, which covers the period of twelve months ended on 30th September, 1956, was as follows :—

	Salmon		Sea Trout		Total	
	Number	lb.	Number	lb.	Number	lb.
Nets ...	63,362	443,387	2,436	3,410	65,798	446,797
Rods ...	3,527	24,535	3,374	3,759	6,901	28,294
Total ...	66,889	467,922	5,810	7,169	72,699	475,091

The total yield in the 1956 season was almost up to average. The prevalence of heavy flood conditions brought the fish quickly through the lower waters thus favouring the upstream netsmen and anglers who had better catches than in 1955.

The Commission continued to operate for its own account the several fishery in that part of the River Foyle which flows through County Derry.

With the approval of the Minister and Ministry, the Commission made the following regulations :—

Foyle Area (Rivers Finn and Foyle) (Close Season for Angling) Regulations, 1956, dated 28th March, 1956, and

Foyle Area (Control of Netting) Regulations, 1956, dated 29th March, 1956.

INLAND FISHERIES TRUST, INCORPORATED.—During the year under review the Inland Fisheries Trust, Incorporated continued its work of promotion and development of brown trout fisheries. For this purpose a grant-in-aid, which amounted to £10,500 in the financial year 1956/57, is provided annually from the Fisheries Vote. Details of the Trust's activities during the preceding year and financial statements are given in the Secretary's Report presented to the Seventh Annual General Meeting of the Trust held on 31st May, 1957. The membership of the Trust continued to increase during 1956 and stood at about 3,250 at the end of the year. While no new waters were acquired by the Trust during the year, coarse fish were removed from portion of the River Lee prior to flooding in connection with the hydro-electric development work being carried out by the Electricity Supply Board. Trust members may now fish on the Upper Carrigadrohid Reservoir on the Lee, the fishing rights on which are vested in the Electricity Supply Board. In addition, the Western Lakes Scheme was extended to Lough Carra and work was commenced on the development of the Killarney Lakes, whence some 85,000 perch were removed during the year. From funds provided for the purpose by An Bord Fáilte Éireann development work was commenced and substantially completed on Glenbower Lake, Co. Cork. An engineering survey with a view to future development work was carried out during the year on Reenydonegan Lake, near Bantry. The removal of coarse fish from Derravaragh Lake, Co. Westmeath was also continued. In addition to these special features of its work during 1956 the Trust continued its general development activities which include the salvage of trout and salmon parr, the restocking of waters and the removal of coarse fish from waters deemed to be especially suitable for brown trout. The investigations into the effect of long-lining for eels on trout fishing in lakes such as Lough Arrow and the experiments in the use of electrical fishing equipment, which were commenced in 1955, were continued. As in previous years the Trust co-operated with An Bord Fáilte Éireann in fishery matters. Towards the end of the year as part of general measures for the relief of unemployment the Trust commenced a scheme for clearance of natural obstacles to fishing and for the provision of easy access to suitable fishing waters. Operations under this scheme were commenced on the Rivers Brosna and Little Brosna. During 1956 legal formalities in connection with the acquisition of a site (near Roscrea) for the establishment by the Trust of a

fish farm were completed. Clearance and excavation work were immediately commenced and by the end of the year considerable progress had been made with the construction work.

SALMON RESEARCH TRUST OF IRELAND INCORPORATED.—This Trust (incorporated on 1st June, 1955) was promoted under the joint auspices of the Minister for Agriculture and Messrs. Arthur Guinness Son and Company, Limited, and has as its main object the conduct of scientific research directed towards the general improvement in the public interest of salmon and sea-trout fisheries. Details of the activities of the Trust and financial statements are given in the Report of the Chairman of the Committee of Management of the Trust for the year ended 31st December, 1956. A Biologist was appointed to the Trust early in the year and a preliminary survey was made by him of the catchment area of the Burrishoole River, where the Trust is conducting its research work. Rearing ponds were completed at Treanlaur and plans for the erection there of a laboratory were approved towards the end of the year. Experiments were conducted for separate study of fry derived respectively from parents identified as spring fish and from parents identified as grilse. The activities of the Trust are financed by contributions from Fisheries Vote and from the Company.

ENGINEERING.—The two reservoirs on the River Lee connected with the hydro-electric development of that river were filled in the autumn to low water levels of the reservoirs at which point the hydraulic lift fish passes commenced to function, and will be maintained at those levels until the stations are ready to come into service. During the filling process, which is necessarily slow, salmon were held up below the dams. A number were removed for stripping and hatching of the ova. Examination of some Lee tributaries opened up to spawning fish immediately prior to the commencement of work on the hydro-electric scheme, revealed that they were being frequented by salmon ; and some contained a large number of redds.

The Electricity Supply Board decided to construct a fish pass of the hydraulic lift type at Ardnacrusha power station in order that salmon which had moved up into the tail race should be able to ascend to the head race and thence up into the Shannon system. Construction work on the project, which had for some years been advocated by Fisheries Division, commenced in the Autumn.

Work on the River Clady progressed and the fish passes in the dams were completed, but the filling of reservoirs had not begun during the year.

Arterial drainage work was continued by the Office of Public Works with effects on fisheries of varying degrees. Model experiments on different types of fish passes intended to be incorporated in the new sluice barrage proposed for construction

in Galway were carried out in London by the consulting engineers to the Office of Public Works. As a result of those experiments it was decided that a Denil type of pass as designed in Fisheries Division should be constructed in the barrage. Elver passes in the barrage were redesigned to the requirements of Fisheries Division. A fish pass was constructed at Aclare House weir in the Glyde and Dee catchment, drainage work on which progressed towards the final stages. Designs for a fish pass at Ballyartella milldam on the Nenagh river, and for small fishways at bridge aprons on the River Feale catchment were prepared in accordance with requirements of the Fishery engineers. Drainage work on the Rye River, a tributary to the Liffey, approached completion during the year ; works to mitigate the effects of drainage on the fisheries of the stream were agreed and approval obtained for their execution. Preliminary examinations were made of arterial drainage projects for the following catchments : Maine, Inny, Boyne, Deele-Swillyburn.

Consultation continued throughout the year with representatives of Bord na Mona. A silt trap to intercept bog drainage water flowing into the Owenmore River at Bellacorrick was constructed by Bord na Mona and achieved a measure of success, proportionate to its capacity, in removing suspended material.

A fry pass to the design of Fisheries Division was installed in one of the canal lock gates at Muine Bheag and was reported to have functioned satisfactorily during the period of the smolt run in which it operated. Advice was given to several Boards of Conservators as to the provision of fishways in some natural obstructions.

Observations necessary for re-definition of the tidal and freshwater boundary of the River Feale were completed.

The Inspector and Engineer who continued to act as Chairman of An Bord Iascaigh Mhara attended at Rotterdam, Holland an international congress held under the auspices of F.A.O. to deal with fish quality and the freezing of fish. This officer also provided material for a new edition of Fish Marketing in O.E.E.C. countries, which was first published by O.E.E.C. in 1951. The Assistant Engineer presented to the Institution of Civil Engineers of Ireland a paper entitled " Inland Fisheries and the Engineer ". At the request of the Council of the Institution the paper was read for a second time at a provincial meeting of the Institution in Galway. The Assistant Engineer continued to act as a member of the Council of the Inland Fisheries Trust. This officer also undertook the design of the Fish Farm, work on which is being carried out at Roscrea, Co. Tipperary under his general supervision.

Advice and assistance on various engineering matters affecting fisheries were afforded to Boards of Conservators, The Foyle Fisheries Commission, the Salmon Research Trust and Angling Associations.

LEGISLATION.—The Fisheries (Statute Law Revision) Act, 1956, an Act to facilitate the intended consolidation of the fisheries enactments, became law during the year. Towards the end of the year preparations were being made for the introduction in Seanad Éireann of the Fisheries Consolidation Bill, a measure designed to consolidate in one Act the Fisheries Acts, 1842 to 1956, and certain other enactments relating to fisheries.

During the year one Statutory Instrument, two Bye-laws and one Definition were made, particulars of which are given in Appendix 20.

(Sd.) ERSKINE CHILDERS

MINISTER FOR LANDS.

21st DECEMBER, 1957.

NOTE.—By virtue of the Fisheries (Transfer of Departmental Administration and Ministerial Functions) Order, 1957 (S.I. No. 67 of 1957) the functions vested in the Minister for Agriculture under the Fisheries Acts were transferred to the Minister for Lands, as and from 9th April, 1957.

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APPENDIX No. 1.

Total Quantity and Value of SEA FISH (excluding Salmon) returned as LANDED during the year 1956.

KINDS OF FISH	EAST COAST (Omeath to Carnsore Point)		SOUTH COAST (Carnsore Point to Loop Head)		WEST COAST (Loop Head to Erris Head)		NORTH COAST (Erris Head to Moville)		TOTAL	
	Cwts.	£	Cwt.	£	Cwt.	£	Cwt.	£	Cwt.	£
Brill	109	1,160	901	7,870	175	1,579	248	3,098	1,433	13,707
Cod	11,805	57,796	4,070	16,873	501	2,214	4,962	21,766	21,338	98,649
Conger Eel ...	233	422	115	227	—	—	94	260	442	909
Haddock ...	3,212	8,309	14,027	30,596	527	1,782	11,142	24,938	28,908	65,625
Hake	914	6,203	200	717	55	303	259	1,195	1,428	8,418
Ling	197	465	91	209	—	—	132	395	420	1,069
Plaice	8,344	55,123	9,794	67,322	1,271	10,639	6,005	47,668	25,414	180,752
Ray or Skate ...	9,405	24,001	11,294	26,713	3,551	6,466	4,504	13,592	28,754	70,772
Soles	317	5,419	1,284	13,623	131	1,596	212	3,790	1,944	24,428
Turbot	132	1,256	608	5,421	113	1,095	199	2,497	1,052	10,269
Whiting	40,076	44,831	29,929	50,930	8,690	15,860	6,963	13,137	85,658	124,758
Other kinds ...	4,160	11,227	13,045	27,864	4,674	9,005	6,818	13,195	28,697	61,291
TOTAL DEMERSAL ...	78,904	216,212	85,358	248,365	19,688	50,539	41,538	145,531	225,488	660,647
Herrings	5,937	6,596	66,959	43,007	2,171	3,407	62,782	48,598	137,849	101,608
Mackerel	9	25	10,300	17,768	482	1,299	3,059	5,723	13,850	24,815
Sprats	—	—	—	—	—	—	180	90	180	90
TOTAL PELAGIC ...	5,946	6,621	77,259	60,775	2,653	4,706	66,021	54,411	151,879	126,513
TOTAL WET FISH ...	84,850	222,833	162,617	309,140	22,341	55,245	107,559	199,942	377,367	787,160
	No.		No.		No.		No.		No.	
Crabs	28,074	556	54,180	1,237	—	—	22,025	423	104,279	2,216
Crayfish	—	—	76,839	22,326	45,720	12,320	2,052	513	124,611	35,159
Escallops	—	—	239,764	3,387	430,931	5,286	—	—	670,695	8,673
Lobsters	52,210	8,984	190,134	40,004	127,248	25,570	183,708	32,684	553,300	107,302
Oysters	—	—	35,100	365	219,138	2,323	—	—	254,238	2,688
	Cwt.		Cwt.		Cwt.		Cwt.		Cwt.	
Norway Lobsters ...	3,894	11,053	36	130	—	—	180	450	4,110	11,633
Mussels	7,990	3,019	28,217	6,365	—	—	—	—	36,207	9,384
Periwinkles	4,620	4,620	18,547	19,360	24,021	24,376	7,460	7,620	54,648	55,976
Other Shellfish ...	73	228	221	375	—	—	—	—	294	603
TOTAL VALUE SHELLFISH	—	28,460	—	93,609	—	69,875	—	41,690	—	233,634
TOTAL VALUE ALL FISH	—	251,293	—	402,749	—	125,120	—	241,632	—	1,020,794

APPENDIX No. 2.

Comparison for the eight years, 1949–56, of the Average Prices per cwt. of various kinds of Sea Fish.

	1949	1950	1951	1952	1953	1954	1955	1956
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Brill	7 12 9	8 6 5	7 14 5	8 14 11	9 7 10	8 9 10	8 15 3	9 11 4
Cod	4 13 6	4 14 2	4 15 3	4 5 7	4 11 4	5 1 4	4 14 0	4 12 6
Conger Eel ...	1 13 5	1 16 7	1 18 0	1 16 2	1 3 2	1 11 0	1 15 5	2 1 2
Haddock ...	3 16 3	4 7 0	4 15 4	3 12 8	2 2 2	2 8 5	2 0 2	2 5 5
Hake ...	4 10 0	4 7 4	3 8 11	2 18 7	2 18 0	3 18 3	4 17 6	5 17 11
Ling	2 7 7	2 5 9	2 5 3	3 6 0	3 16 4	3 10 7	2 10 5	2 10 11
Plaice ...	5 15 0	5 15 0	5 19 2	5 10 11	5 8 9	7 11 2	7 3 7	7 2 3
Ray or Skate ...	1 17 11	2 2 8	2 3 9	2 5 10	2 12 5	2 12 11	2 8 8	2 9 3
Soles	10 2 4	9 18 9	10 5 9	10 8 9	9 12 6	11 5 5	11 5 0	12 11 4
Turbot ...	7 16 7	7 10 0	7 12 4	7 19 8	9 7 1	8 9 0	7 18 9	9 15 3
Whiting ...	1 10 8	1 12 10	1 13 9	1 12 10	1 14 0	1 12 8	1 12 0	1 9 2
Herrings ...	1 1 10	0 16 4	1 2 10	1 2 0	1 3 9	1 1 4	0 15 3	0 14 9
Mackerel ...	1 8 3	1 0 7	1 3 5	1 12 3	1 9 11	1 9 9	1 12 9	1 15 10
Sprats ...	0 6 1	0 5 1	0 6 3	0 8 3	0 8 0	0 3 6	0 4 2	0 10 0

N.B.—"Average price" as shown in this table represents total value divided by total weight for each kind of fish, year by year. It does not purport to take direct cognizance of any abnormal rise or fall in price attributable to a seasonal glut or shortage of a particular kind of fish.

APPENDIX No. 3.

FISH IMPORTS AND EXPORTS, 1956.

(as compared with those of 1955).

	Quantity		Value	
	1956	1955	1956	1955
	cwt.	cwt.	£	£
I.—IMPORTS				
Fish (except shellfish) not canned:				
Fresh, chilled or frozen...	5,785	8,097	17,265	27,827
Dried, salted, smoked or cooked	27,750	32,597	151,036	163,608
Shellfish, not canned ...	3,376	5,553	14,109	22,636
Fish (including shellfish) and fish preparations canned	28,930	41,243	517,014	843,318
TOTALS ...	65,841	87,490	699,424	1,057,389
II.—EXPORTS				
Fish (except shellfish) fresh, chilled or frozen				
Salmon	13,564	11,135	557,016	451,874
Herrings	46,086	31,389	64,556	55,683
Fresh water eels ...	2,292	1,922	29,545	22,951
Other fish	16,822	5,457	26,322	7,199
Fish dried, salted or smoked, not canned...	20,080	8,053	38,896	30,728
Shellfish fresh, chilled, frozen, salted, dried...	84,962	69,390	311,525	288,033
Fish (including shellfish) and fish preparations canned	1	45	27	899
TOTALS ...	183,807	127,391	1,027,887	857,967

The figures given above for exports of salmon and trout include those relating to exports from the former Moville Fishery District now comprised in the Foyle Area.

APPENDIX No. 4.

HERRING FISHING, 1956.

County	Ports at which more than 500 cwt. were landed.	Total Quantity cwt.	Value £
Louth ...	Greenore & Carlingford	2,930	3,045
Dublin		10	16
Wicklow	Arklow	1,657	2,273
Wexford ...	Kilmore ... ... Duncannon	2,600	2,532
Waterford ...	Dunmore East ...	60,522	36,839
Cork ...	Ballycotton ... ... Castletownbere	4,721	4,414
Kerry		456	484
Clare		161	527
Galway		510	810
Mayo ...	Achill ... ... Keel & Keem	1,500	2,070
Sligo		5	12
Donegal ...	Killybegs Burton Port Kincasslagh ... ... Bunbeg Downings	62,777	48,586
	TOTALS ...	137,849	101,608

APPENDIX No. 5.

MACKEREL FISHING, 1956.

County	Ports at which more than 250 cwt. were landed.	Total Quantity cwt.	Value £
Louth		7	19
Dublin		2	6
Wexford ...	Kilmore Quay ... Duncannon	700	850
Waterford ...	Dunmore East Tramore Bunmahon ... ... Dunabratton Ballinagoul	1,845	2,480
Cork ...	Old Head Ballycotton ... ... Baltimore Schull	6,070	11,444
Kerry ...	Cahirciveen ... ... Dingle	1,685	2,994
Clare		180	580
Galway		120	384
Mayo	Lacken	1,789	3,044
Sligo		115	230
Donegal	Malinbeg	1,337	2,784
	TOTALS ...	13,850	24,815

APPENDIX No. 6.

PERSONNEL ENGAGED IN FISHING; AND REGIONAL DISTRIBUTION AND CLASSIFICATION OF FISHING CRAFT IN 1956.

HOW ENGAGED (i.e., whether solely or partially)	MEN	Steam Vessels		Motor Vessels						Sail Boats						Row Boats		Total Vessels
				1st Class			2nd Class		3rd Class	1st Class			2nd Class		3rd Class	Unclassed A	Unclassed B	
		200 tons gross and over	100 tons gross and over but less than 200 tons.	25 tons gross and over.	20 tons gross and over but less than 25 tons.	15 tons gross and over but less than 20 tons.	10 tons gross and over but less than 15 tons and of 18 feet keel and upwards.	Under 10 tons and of 18 feet keel and upwards.	Less than 18 feet keel.	25 tons net and over.	20 tons net and over but less than 25 tons.	15 tons net and over but less than 20 tons.	10 tons net and over but less than 15 tons and of 18 feet keel and upwards.	Under 10 tons and of 18 feet keel and upwards.	Less than 18 feet keel.	Open boats of 18 feet keel and upwards and canoes of 18 feet or more over all.	Open boats of less than 18 feet keel and canoes of less than 18 feet over all.	
EAST COAST:																		
Solely engaged	441	—	—	46	7	7	6	18	—	—	—	—	—	2	1	33	4	123
Partially engaged	376	—	—	1	1	4	2	18	—	—	—	—	—	12	4	52	1	101
Laid-up	—	—	—	1	—	—	3	1	—	—	—	—	—	4	5	9	1	24
Totals	817	—	—	48	8	11	11	37	—	—	—	—	—	18	9	94	12	248
SOUTH COAST:																		
Solely engaged	610	—	—	40	3	7	31	115	2	—	—	—	4	47	27	158	34	468
Partially engaged	1,227	—	—	—	—	—	7	42	2	—	—	—	2	34	27	108	50	279
Laid-up	—	—	—	—	—	—	—	8	2	—	—	—	—	5	10	12	8	45
Totals	1,837	—	—	40	3	7	38	171	7	—	—	—	6	86	64	278	92	792
WEST COAST:																		
Solely engaged	233	—	—	9	5	3	3	29	—	—	—	—	—	41	10	194	154	448
Partially engaged	1,730	—	—	—	2	2	1	10	—	—	—	—	—	26	30	88	144	303
Laid-up	—	—	—	—	—	1	—	1	—	—	—	—	—	9	—	14	12	37
Totals	1,963	—	—	9	7	6	4	40	—	—	—	—	—	76	40	296	310	788
NORTH COAST:																		
Solely engaged	300	—	—	19	1	6	9	102	—	—	—	—	—	114	6	117	34	408
Partially engaged	1,519	—	—	2	—	2	3	31	1	—	—	—	1	54	9	54	44	201
Laid-up	—	—	—	—	—	—	—	7	—	—	—	—	—	12	2	3	12	36
Totals	1,819	—	—	21	1	8	12	140	1	—	—	—	1	180	17	174	90	645
TOTALS FOR 1956:																		
Solely engaged	1,584	—	—	114	16	23	49	264	2	—	—	—	4	204	43	502	226	1,447
Partially engaged	4,852	—	—	3	3	8	13	107	4	—	—	—	3	126	70	302	245	884
Laid-up	—	—	—	1	—	1	3	17	2	—	—	—	—	30	17	38	33	142
Totals	6,436	—	—	118	19	32	65	388	8	—	—	—	7	360	130	842	504	2,473

APPENDIX No. 7.

TRAWLING AND SEINING, 1956.

Port or Locality	Number of men engaged	Number of boats engaged	Tonnage of Motor Boats: Not exceeding 10 tons	Tonnage of Motor Boats: Over 10 tons	Tonnage of Motor Boats: Over 15 tons	Fishing Period
Clogher Head	40	7			7	All year.
Balbriggan	25	5			5	All year.
Skerries	5	1			1	All year.
Loughshinny	30	6			6	All year from Skerries.
Howth	75	10			10	All year.
Dublin	19	4			2	All year.
Dún Laoghaire	30	5			5	May to September.
Bray	3	1	1			May to September.
Greystones	6	1				All year.
Wicklow	5	1			1	All year.
Arklow	80	13	13	1	16	All year.
Courtown	3	1				May to November.
Wexford	40	7	7		7	All year.
Rosslare Harbour	12	2	2		2	All year.
Kilmore Quay	60	10			3	All year.
Bannow and Bar of Lough	8	2				April to November.
Duncannon	14	4				All year.
Passage East	25	6	10		2	All year.
Dunmore East	30	6			6	All year.
Tramore	8	2	2			April to September.
Helvick	24	3			1	All year.
Ballycotton	20	5	1			All year.
Youghal	5	1	1		1	All year.
Ratheoursey	3	1				All year.
Cobh	20	3	1			May to September.
Passage West	9	3	3			May to September.
Crosshaven	4	1	1			All year.
Kinsale	4	1	1			All year.
Dooneen	4	1	1		1	All year.
Union Hall	24	4	4		1	All year.
Castletownsend	30	4	4			All year.
Baltimore	12	3	3			All year.
Schull	20	3	2			All year.
Bantry	50	8	8		1	All year.
Castletownbere	12	3	3		1	All year.
Kilmakillogue	12	3	3			All year.
Sneem	12	3	3			All year.
Dalliskellig	6	1	1			April to September.
Portmagee	8	1	1		1	All year.
Cahirciveen	24	4	4		1	All year.
Dingle	24	4	4			All year.
Fenit	60	12	12		1	All year.
Liscannor	4	1	1			April to October.
Aran Islands	8	2	2			All year.
Galway	24	4	4		1	All year.
Carna	30	6	6		4	All year.
	4	1	1		1	All year.
Clegan	14	4	2		1	All year.
Murrisk	5	1	1			February to August.
Achill	35	8	2	3	1	All year.
Blalina	7	2	1			June to September.
Lacken	9	3	3		1	May to October.
Kilcummin	13	4	4		1	May to October.
Enniscrone	13	4	4			April to November.
Ballinrobe	8	2	2			May to September.
Killybegs	102	13	13		13	All year.
Teelin	6	1	1			All year.
Burtonport	6	1	1			March to September.
Kincasslagh	6	1	1			April to November.
Bunbeg	8	2	2			March to September.
Dunfanaghy	8	2	2			June to September.
Downings	15	3	3		1	All year.
Buncrana	10	3	3		1	All year.
Culdaff	30	8	8		2	April to December.
Greencastle	54	14	14		1	All year.
Moville	23	6	6		2	All year.
TOTALS	1,335	284	81	49	154	

APPENDIX No. 8.

STATEMENT OF ACCOUNT

in respect of

Repayable Advances made to the Irish Sea Fisheries Association, Ltd., during the period of twenty-five years to the date of the Association's dissolution, 23rd April, 1952, and to An Bórd Iascaigh Mhara, as from that date to 31st March, 1956, for the provision of boats and gear to fishermen.

	£		£
Repayable with Interest on an annuity basis in respect of :—		Repayments to 31st March, 1955	222,042
(*a*) Advances amounting to £613,500, made up to 31st March, 1955	927,671	Repayments made during year ended 31st March, 1956	24,433
(*b*) Advances amounting to £116,142, made during year ended 31st March, 1956	181,203	Balance outstanding :—	
		Due in arrear £87,523	
		Instalments and Interest not matured ... £774,876	862,399
	£1,108,874		£1,108,874

NOTE.—Advances made to the Association and the Board are repayable on the basis of a twenty year annuity in half-yearly instalments.

APPENDIX No. 9.

Quantity and Value of all Salmon and Sea Trout taken in each of the Three Years 1954, 1955 and 1956 by Instruments of Capture.

SALMON.

	1956	1955	1954	1956	1955	1954
	lb.	lb.	lb.	£	£	£
(A) ...	1,443,340	1,261,402	1,976,077	415,931	363,788	500,243
(B) ...	264,232	246,537	293,091	76,940	69,082	74,555
(C) ...	250,723	234,648	474,511	66,934	63,043	117,790
(D) ...	720,851	606,437	921,332	207,120	175,569	230,052
(E) ...	207,534	173,780	287,743	64,917	56,094	77,846

SEA TROUT.

	1956	1955	1954	1956	1955	1954
	lb.	lb.	lb.	£	£	£
(A) ...	93,152	73,201	70,854	15,136	10,824	10,800
(B) ...	56,192	42,285	48,334	8,519	5,931	7,117
(C) ...	1,231	1,432	2,054	177	246	376
(D) ...	33,599	27,509	19,462	5,964	4,273	3,122
(E) ...	2,130	1,975	1,004	476	374	185

(A)=Total for *all* engines.
(B)=Total for rod and line.
(C)=Total for drift nets.
(D)=Total for draft nets.
(E)=Total for stake nets, weirs, etc.

The tables in Appendices Nos. 9 to 15 do not include returns from the former Moville Fishery District.

APPENDIX No. 10.

Quantity and Value of Salmon taken in each of the Three Years 1954, 1955 and 1956 by Fishery Districts.

Fishery District	*	Quantity			Value		
		1956 lb.	1955 lb.	1954 lb.	1956 £	1955 £	1954 £
Dublin ...	R	5,761	4,703	3,167	1,994	1,591	922
	N	3,036	4,329	3,883	995	1,260	1,081
Wexford ...	R	18,467	24,059	21,290	5,543	7,079	5,595
	N	25,001	40,768	39,361	9,127	13,096	12,136
Waterford ...	R	31,242	33,854	36,816	9,506	9,745	9,493
	N	160,454	111,742	250,278	46,607	33,133	62,009
Lismore ...	R	30,878	37,596	42,550	9,018	10,164	10,349
	N	123,487	142,713	260,684	35,227	41,833	65,265
Cork ...	R	26,169	28,383	32,003	8,466	8,644	8,386
	N	76,150	78,487	184,432	26,614	27,656	51,871
Kerry ...	R	25,518	21,069	26,940	7,330	5,571	6,773
	N	115,118	94,240	150,186	31,267	26,466	32,615
Limerick ...	R	45,445	34,117	51,484	13,415	9,342	13,177
	N	146,530	115,898	196,005	45,996	35,850	53,500
Galway ...	R	7,734	4,438	3,452	2,225	1,285	914
	N	36,507	9,685	43,447	11,615	2,876	10,620
Connemara ...	R	5,409	5,526	4,864	1,623	1,658	1,276
	N	Nil	Nil	Nil	Nil	Nil	Nil
Ballinakill ...	R	6,277	4,461	4,792	1,474	1,263	1,182
	N	10,739	11,567	25,025	2,412	2,340	5,344
Bangor ...	R	4,628	4,543	6,171	1,354	1,257	1,478
	N	39,512	65,508	70,357	11,678	15,339	17,742
Ballina ...	R	23,443	14,567	18,266	5,870	3,379	4,353
	N	217,671	132,719	155,485	53,569	36,975	37,555
Sligo ...	R	3,643	3,303	4,469	1,037	859	1,105
	N	39,249	18,045	20,577	11,026	5,648	6,136
Ballyshannon ...	R	3,080	2,494	3,087	949	753	758
	N	53,094	55,013	74,028	13,932	14,235	18,234
Letterkenny ...	R	20,568	14,293	20,656	5,046	3,375	4,771
	N	76,318	76,431	123,209	18,352	19,362	26,238
Dundalk ...	R	1,279	538	710	338	139	151
	N	16,930	16,762	24,931	5,352	4,678	6,500
Drogheda ...	R	4,691	8,593	12,374	1,752	2,978	3,872
	N	39,312	40,958	61,638	15,222	13,959	18,842
TOTALS ...		1,443,340	1,261,402	1,976,677	415,931	363,788	500,243

*R indicates capture by means of single rod and line; N by means of nets, weirs, etc.

APPENDIX No. 11.

Quantity and Value of Sea Trout taken in each of the Three Years 1954, 1955 and 1956 by Fishery Districts.

Fishery District	*	Quantity			Value		
		1956 lb.	1955 lb.	1954 lb.	1956 £	1955 £	1954 £
Dublin ...	R	1,553	841	1,198	256	133	192
	N	6,703	7,677	4,067	1,414	1,245	809
Wexford ...	R	2,624	2,771	2,964	408	388	414
	N	6,512	3,985	2,822	950	534	423
Waterford ...	R	1,204	870	561	171	110	86
	N	443	294	228	87	49	40
Lismore ...	R	436	550	507	60	79	81
	N	910	1,106	1,554	113	146	196
Cork ...	R	6,644	8,454	5,857	947	1,146	805
	N	1,583	2,469	893	229	354	93
Kerry ...	R	12,310	8,000	13,489	2,140	1,171	1,939
	N	2,425	3,070	2,349	516	521	313
Limerick ...	R	1,965	986	1,167	303	160	202
	N	10,107	4,275	6,748	1,999	827	1,257
Galway ...	R	1,747	809	1,075	279	147	147
	N	1,453	97	89	221	13	15
Connemara ...	R	10,880	8,842	9,549	1,360	1,106	1,432
	N	Nil	Nil	Nil	Nil	Nil	Nil
Ballinakill ...	R	4,734	2,670	2,526	734	370	378
	N	187	502	150	22	58	14
Bangor ...	R	4,801	1,997	2,550	717	296	363
	N	724	1,395	729	103	178	107
Ballina ...	R	549	167	354	73	25	67
	N	321	197	114	34	25	15
Sligo ...	R	371	131	213	63	19	31
	N	127	85	92	18	10	18
Ballyshannon ...	R	553	295	270	80	43	36
	N	150	2,424	333	18	389	45
Letterkenny ...	R	3,845	3,392	3,370	576	492	534
	N	954	478	681	151	61	99
Dundalk ...	R	362	201	258	58	29	41
	N	1,364	1,396	1,117	275	210	129
Drogheda ...	R	1,614	1,309	2,426	294	217	369
	N	2,797	1,476	554	467	273	110
TOTALS ...		93,152	73,201	70,854	15,136	10,824	10,800

*R indicates capture by single rod and line; N by means of nets, weirs, etc.

APPENDIX No. 12.

Quantity and Value of Eels taken in each of the Three Years 1954, 1955 and 1956 by Fishery Districts.

Fishery District	Quantity			Value		
	1956 lb.	1955 lb.	1954 lb.	1956 £	1955 £	1954 £
Waterford ...	2,631	8,543	4,949	236	706	385
Limerick	94,627	89,678	87,511	11,683	9,568	11,658
Galway	50,253	52,865	32,584	6,625	5,800	4,079
Bangor	Nil	Nil	91	Nil	Nil	12
Ballina	9,066	13,509	3,836	885	1,325	384
Sligo	5,704	4,263	2,920	463	350	353
Ballyshannon ...	4,040	5,744	1,030	402	564	78
Dundalk	5,906	4,348	3,395	546	347	332
Drogheda ...	8,696	8,227	7,056	996	773	712
TOTALS ...	180,923	187,177	143,372	21,836	19,433	17,993

NOTE.—Eel Fishing was not carried on in the following Districts during the period 1954/56 : Dublin, Wexford, Lismore, Cork, Kerry, Connemara, Ballinakill and Letterkenny.

APPENDIX No. 13.

Total Quantity and Value of Salmon, Sea Trout and Eels taken by all engines in each of the Three Years 1954, 1955 and 1956 by Fishery Districts.

Fishery District	Total Weight for District			Total Value for District		
	1956 lb.	1955 lb.	1954 lb.	1956 £	1955 £	1954 £
Dublin ...	17,053	17,550	12,315	4,659	4,229	3,004
Wexford ...	52,604	71,583	66,437	16,028	21,097	18,568
Waterford ...	195,974	155,303	292,832	56,607	43,743	72,013
Lismore ...	155,711	181,965	305,295	44,418	52,222	75,891
Cork	110,546	117,783	223,185	36,256	37,800	61,155
Kerry	155,371	126,379	192,964	41,253	33,729	41,640
Limerick ...	298,674	244,954	342,915	73,396	55,747	79,794
Galway ...	97,694	67,894	80,647	20,965	10,121	15,775
Connemara ...	16,289	14,368	14,413	2,983	2,764	2,708
Ballinakill ...	21,937	19,200	32,493	4,642	4,031	6,9[illegible]8
Bangor ...	49,665	73,443	79,898	13,852	17,070	19,702
Ballina ...	251,050	161,159	178,055	60,431	41,729	42,374
Sligo	49,094	25,827	28,271	12,607	6,886	7,643
Ballyshannon ...	60,917	65,970	78,748	15,381	15,984	19,151
Letterkenny ...	101,685	94,594	147,976	24,125	23,290	31,642
Dundalk ...	26,041	23,245	30,411	6,569	5,403	7,153
Drogheda ...	57,110	60,563	84,048	18,731	18,200	23,905
TOTALS...	1,717,415	1,521,780	2,190,903	452,903	394,045	529,036

APPENDIX No. 14.

Number, Quantity and Value of Salmon taken by Single Rod and Line during each of the Three Years 1954, 1955 and 1956 by Fishery Districts.

Fishery District	No. of Fish			Quantity			Value		
	1956	1955	1954	1956	1955	1954	1956	1955	1954
				lb.	lb.	lb.	£	£	£
Dublin ...	746	504	296	5,761	4,703	3,167	1,994	1,591	922
Wexford ...	1,834	2,268	2,097	18,467	24,059	21,290	5,543	7,079	5,595
Waterford ...	4,442	3,496	3,799	31,242	33,854	36,816	9,506	9,745	9,493
Lismore ...	3,562	4,073	4,622	30,878	37,596	42,550	9,018	10,164	10,349
Cork ...	3,185	3,000	3,439	26,169	28,383	32,003	8,466	8,644	8,386
Kerry ...	3,591	2,777	3,238	25,518	21,069	26,940	7,330	5,571	6,773
Limerick ...	6,718	4,312	6,150	45,445	34,117	51,484	13,415	9,342	13,177
Galway ...	1,176	712	436	7,734	4,438	3,452	2,225	1,285	914
Connemara ...	601	614	608	5,409	5,526	4,864	1,623	1,658	1,276
Ballinakill ...	952	662	655	6,277	4,461	4,792	1,474	1,263	1,182
Bangor ...	710	532	731	4,628	4,543	6,171	1,354	1,257	1,478
Ballina ...	3,698	2,227	2,302	23,443	14,567	18,266	5,870	3,379	4,353
Sligo ...	488	415	538	3,643	3,303	4,469	1,037	859	1,105
Ballyshannon	399	309	334	3,080	2,494	3,087	949	763	758
Letterkenny ...	3,134	2,058	2,955	20,568	14,293	20,656	5,046	3,375	4,771
Dundalk ...	141	50	66	1,279	538	710	338	139	151
Drogheda ...	380	552	961	4,691	8,593	12,374	1,752	2,978	3,872
TOTALS...	35,757	28,561	32,225	264,232	246,537	293,091	76,940	69,082	74,555

APPENDIX No. 15.

Number, Quantity and Value of Sea Trout taken by Single Rod and Line during each of the Three Years 1954, 1955 and 1956 by Fishery Districts.

Fishery District	No. of Fish			Quantity			Value		
	1956	1955	1954	1956	1955	1954	1956	1955	1954
				lb.	lb.	lb.	£	£	£
Dublin ...	1,776	1,020	1,269	1,553	841	1,198	256	133	192
Wexford ...	3,480	4,207	4,419	2,624	2,771	2,964	408	388	414
Waterford ...	1,203	910	567	1,204	870	561	171	110	86
Lismore ...	581	510	549	436	550	507	60	79	81
Cork ...	7,961	12,071	7,419	6,644	8,454	5,857	947	1,146	805
Kerry ...	10,668	6,425	11,644	12,310	8,000	13,489	2,140	1,171	1,939
Limerick ...	2,362	1,258	1,373	1,965	986	1,167	303	160	202
Galway ...	2,002	860	1,231	1,747	809	1,075	279	147	147
Connemara ...	10,880	8,842	9,549	10,880	8,842	9,549	1,360	1,106	1,432
Ballinakill ...	4,124	2,712	2,766	4,734	2,670	2,526	734	370	378
Bangor ...	5,415	1,963	2,470	4,801	1,997	2,550	717	296	363
Ballina ...	577	158	422	549	167	354	73	25	67
Sligo ...	286	74	189	371	131	213	63	19	31
Ballyshannon	527	306	314	553	295	270	80	43	36
Letterkenny ...	3,577	4,143	4,252	3,845	3,392	3,370	576	492	534
Dundalk ...	408	222	273	362	201	258	58	29	41
Drogheda ...	1,888	1,073	2,099	1,614	1,309	2,426	294	217	369
TOTALS...	57,715	46,754	50,705	56,192	42,285	48,334	8,519	5,931	7,117

APPENDIX No. 16.

RECEIPTS AND EXPENDITURE OF BOARDS OF CONSERVATORS FOR THE YEAR 1956.

Fishery District	Opening Balance	RECEIPTS						EXPENDITURE					Closing Balance
		Licence Duty	Fishery Rate	Subscriptions	Grant from Department	Miscellaneous Receipts	Total Receipts	Water Keepers	Law Costs	Salaries and Commissions	Travelling and Miscellaneous	Total Expenditure	
	£	£	£	£	£	£	£	£	£	£	£	£	£
Dublin ...	648	879	301	264	—	74	1,518	679	101	784	435	1,999	167
Wexford ...	420	1,145	1,136	—	4	24	2,309	1,497	—	235	431	2,163	566
Waterford ...	2,090	2,292	1,905	—	1,807	133	6,137	4,275	260	1,294	1,588	7,417	810
Lismore ...	1,504	1,294	4,760	—	615	258	6,927	4,629	175	945	1,467	7,216	1,215
Cork ...	397	1,851	1,585	23	3,002	437	6,898	4,122	272	925	1,274	6,593	702
Kerry ...	828	1,824	2,797	—	1,813	248	6,682	3,560	153	1,099	1,179	5,991	1,519
Limerick ...	4,788	2,370	5,003	250*	3,014	454	11,091	4,312	447	1,430	4,492	10,681	5,198
Galway ...	1,469	493	2,175	—	262	44	2,974	1,466	239	647	485	2,837	1,606
Connemara ...	400	532	1,489	—	14	6	2,041	1,618	—	262	256	2,136	305
Ballinakill ...	593	381	704	—	—	9	1,094	850	12	290	206	1,358	329
Bangor ...	717	657	1,101	135	617	33	2,543	1,539	96	424	506	2,565	695
Ballina ...	632	824	3,009	75	408	6	4,322	2,859	38	431	1,072	4,400	554
Sligo ...	910	305	861	—	13	16	1,195	609	13	290	269	1,181	924
Ballyshannon	307	544	1,549†	35	1,113	80	3,321	1,847	6	470	528	2,851	777
Letterkenny ...	1,333	1,544	1,534†‡	—	123	66	3,267	1,930	74	595	633	3,232	1,368
Drogheda ...	831	1,133	1,439	—	602	63	3,237	1,996	40	538	349	2,923	1,145
Dundalk ...	144	211	249	—	302	6	768	208	30	348	140	726	186
TOTALS ...	18,011	18,279	31,597	782	13,709	1,957	66,324	37,996	1,956	11,007	15,310	66,269	18,066

*Contributed by Electricity Supply Board towards purchase of a patrol launch.
†This figure includes £1,117 received under Section 14 (1) of the Fisheries (Tidal Waters) Act, 1934.
‡This figure includes £175 received under Section 14 (1) of the Fisheries (Tidal Waters) Act, 1934.
Sums received by way of Special Local Licence duty which were paid over to the Exchequer in accordance with Section 13 of the Fisheries (Tidal Waters) Act, 1934, are not included in this Table.

APPENDIX No. 17.

PARTICULARS OF LICENCES ISSUED BY BOARDS OF CONSERVATORS FOR THE YEAR 1956.

Fishery District	Salmon Rod				Snap Net	Draft Net	Drift Net	Pole Net	Bag Net	Stake Net	Box or Crib	Gap, Eye or Basket for Eels	Long Lines for Eels	Loop Net	Eel Trap	Special Local Licence (Tidal Waters)
	For one year (£2)	For 14 days (£1)	Issuable at £1 from 1st July onwards	Endorsement or Extension												
Dublin ...	360	6	52	12	—	11	17	—	—	—	—	—	—	—	—	—
Wexford ...	226	77	146	100	—	104	—	2	—	—	—	—	—	—	—	—
Waterford ...	765	23	23	35	10	25	77	—	1	1	3	16	—	—	—	—
Lismore ...	363	153	—	86	21	12	67	—	—	2	1	—	—	—	—	—
Cork ...	580	43	167	38	—	79	47	—	1	—	—	—	—	—	—	—
Kerry ...	519	397	—	122	1	60	1	1	1	—	3	—	—	—	—	—
Limerick ...	740	5	34	116	—	87	67	—	—	4	4	23	19	—	—	—
Galway ...	91	39	126	36	—	8	—	—	—	—	5	21	2	—	—	—
Connemara ...	81	322	—	97	—	—	—	—	—	—	—	—	—	—	—	—
Ballinakill ...	53	72	128	54	—	12	—	—	—	—	—	—	—	—	—	—
Bangor ...	141	161	—	94	—	30	1	—	4	—	—	2	—	—	—	—
Ballina ...	170	109	36	70	—	9	38	—	—	—	—	41	1	—	—	—
Sligo ...	119	7	—	8	—	6	2	—	2	—	—	—	3	—	—	—
Ballyshannon	118	—	—	45	—	50	1	—	—	—	2	2	1	—	2	14
Letterkenny	460	161	—	262	—	20	44	—	—	—	2	—	—	20	—	10
Drogheda ...	311	31	—	72	—	92	—	—	—	—	6	2	1	—	5	—
Dundalk ...	24	—	56	18	—	21	—	—	—	—	—	6	1	—	—	—
TOTALS ...	5,121	1,606	708	1,265	128	635	362	3	8	7	33	111	28	20	7	24

APPENDIX No. 18.

Licence Duty payable on the undermentioned fishing engines.

		£	s.	d.
On each	Salmon Rod (for full year in one District) ...	2	0	0
Do.	Salmon Rod (14 days licence issuable where Board of Conservators so resolves) ...	1	0	0
Do.	Salmon Rod (special licence available 1st July to end of season issuable where a Board of Conservators so resolves) ...	1	0	0
Do.	Salmon Rod (Endorsement, extending a current licence to another District) ...	0	10	0
Do.	Snap Net	2	10	0
Do.	Draft Net or Seine	4	0	0
Do.	Drift Net	3	0	0
Do.	Bag Net	10	0	0
Do.	Fly Net	30	0	0
Do.	Stake Net	30	0	0
Do.	Head Weir	6	0	0
Do.	Box or Crib	10	0	0
Do.	Gap, Eye, or Basket (in eel weir) ...	2	0	0
Do.	Long Line for Eels	2	0	0

On other engines the duty is as follows :—

Fishery District	Polo Net	Loop Net	Eel Trap	Special Local Licences	
				Rod	Draft Net
	£ s.	£ s.	£ s.	£ s.	£ s.
1. Dublin	2 0	—	—	—	—
2. Wexford	2 0	—	—	—	—
3. Waterford	2 0	—	—	—	—
4. Lismore	2 0	—	—	—	—
5. Cork	2 0	—	—	—	—
7. Kerry	2 0	—	—	—	—
8. Limerick	2 0	—	—	—	—
9[1]. Galway	2 0	—	15 0	—	—
9[2]. Connemara	2 0	—	—	—	—
10[1]. Ballinakill	2 0	—	—	—	—
10[2]. Bangor	2 0	—	—	—	—
11. Ballina	2 0	—	—	—	—
12. Sligo	2 0	—	—	—	—
13. Ballyshannon	2 0	—	2 0	*2 0	*40 0
14[1]. Letterkenny	2 0	0 10	—	—	‡12 10
				†2 0	†20 0
17[1]. Drogheda	2 0	0 10	2 0	—	—
17[2]. Dundalk	2 0	—	—	—	—

*River Erne Tidal Waters. †River Lackagh Tidal Waters.

‡River Owenea Tidal Waters.

APPENDIX No. 19.

PUBLIC INQUIRIES HELD DURING THE YEAR 1956.

Date of Inquiry	Where Held	Subject Matter	Decision taken by Fishery Authority on considering Report of Inquiry.
8th and 9th February, 1956.	Dunfanaghy and Bunbeg, Co. Donegal.	Use of ring, seine or trawl nets for capture of herrings from Fanad Head to Glen Head, Co. Donegal.	Bye-law of 11th June, 1908, restricting use of ring nets was revoked.
28th March, 1956 ...	Kilmeena, Co. Mayo	Closure of oyster beds near Quinsheen for further period.	Beds closed for three year period.
28th May, 1956 ...	Lucan	Prohibition of fishing in River Liffey between Leixlip Dam and Leixlip road bridge.	Bye-law made covering limited area between Leixlip dam and the junction of the Rye Water with River Liffey.
22nd August, 1956 ...	Killarney ...	Alteration of close season dates for angling in Kerry Fishery District.	Close season not changed.
22nd August, 1956 ...	Killarney ...	Amendment of bye-law No. 368 prohibiting the use of long lines for taking of eels in the Killarney and Waterville areas of Kerry Fishery District.	Bye-law No. 368 not amended.
28th August, 1956 ...	Navan	Alteration to 9" of the minimum size limit of 8" fixed by bye-law for the capture of salmon and trout in Drogheda Fishery District.	Bye-law made.
12th December, 1956	Ballina	Alteration of close season for angling in Ballina Fishery District.	Bye-law not made.
12th December, 1956	Ballina, Co. Mayo	Prohibition of ground seining in Killala and Lacken Bays.	Bye-law not made.

APPENDIX No. 20.

ABSTRACT OF ORDERS, BYE-LAWS, ETC., MADE DURING THE YEAR 1956.

STATUTORY INSTRUMENTS.

(a) SEA FISHERIES.

Fishing Nets (Regulation of Mesh) Order, 1954 (Amendment) Order, 1956, dated 13th June, 1956.

RELAXING temporarily the minimum sizes for meshes of trawl nets made of single twine containing no manila or sisal.

(b) INLAND FISHERIES.

Ballinakill Fishery District (Electoral Divisions) Order, 1956, dated 13th March, 1956.

ABOLISHING the three subsisting electoral divisions of Ballinakill Fishery District and creating in lieu thereof two new electoral divisions.

BYE-LAWS, ETC.

Clew Bay Oyster Bye-Law.

No. 489—dated 6th June, 1956.

REGULATING for a further period the taking of oysters and oyster brood in part of Clew Bay.

Bye-Law No. 490. Netting off the coast of the County of Donegal —dated 20th June, 1956.

REVOKING Bye-Law dated 11th June, 1908, relating to the use of nets known as "ring" or "Seine" nets.

No. 1 or Dublin District.

Bye-Law No. 491—dated 16th November, 1956.

PROHIBITING fishing in a specified portion of the River Liffey and possession of any mounted fishing rod with line attached thereto on or near the banks of that portion of the River.

APPENDIX No. 20—continued.

No. 17 or Drogheda District.

Bye-Law No. 492—dated 1st December, 1956.

PROHIBITING the taking or killing in the waters of the Drogheda Fishery District or having in possession on or near the banks of those waters, any fish of the salmon or trout kind of less than 9 inches in length and REVOKING Bye-Law No. 398 dated 16th December, 1929.

No. 8 or Limerick District.

Definition No. D.146.

DEFINING the tidal and freshwater boundary of the River Feale and REVOKING the definition of the boundary made on 4th October, 1875.

APPENDIX No. 21.

OUTPUT OF SALMON AND TROUT FRY, 1955/56. (in thousands)

Hatching or Enlarging Station	Where Liberated	Salmon	Sea Trout	Brown Trout
Rathfarnham ...	Blackwater (Kells)	—	—	18
Roundwood ...	Vartry and Bohernabreena Reservoirs, Dargle River ...	—	—	34
Bray	Vartry Lake	5	4	—
Bunclody	Liffey	—	10	10
Enniscorthy ...	Slaney	—	7	—
Abbeyleix ...	Nore and tributaries ...	—	—	13
Lismore	Knockaderry Lake, Glengariff Lake, River Blackwater ...	181	6	69
Mallow	River Blackwater and tributaries	1,100	14	45
St. Anne's (Cork) ...	River Lee and tributaries ...	10	4	30
Clonakilty ...	Argideen River	2	2	1
Glengariff ...	Lakes Pallas, Avaul and Avaul Little, Labe	—	—	18
Gearha	Blackwater	83	—	—
Waterville ...	Waterville—Carhan Rivers ...	20	15	—
Kenmare	Sheen River	85	—	—
Killarney	Killarney Lakes and Rivers, Shrone Lake	200	15	150
Adare	Maigue and tributaries ...	—	—	23
Tulla	Lough Cullane	—	—	7
Loughrea	Lough Rea	—	—	75
Oughterard ...	Lough Corrib and tributaries	—	—	333
Crumlin (Galway) ...	Crumlin River	7	13	—
Spiddal	Spiddal	8	3	—
Tuam	River Close and tributaries, Black River	—	—	10
Inver	Gowla (Cashel) Fishery ...	—	8	—
Clifden	Connemara Lakes	—	5	30
River Suck ...	River Suck and tributaries ...	—	—	95
Treanlaur ...	Burrishoole River and tributaries	213	15	—
Ballisodare ...	Ballisodare River and tributaries	157	5	—
Hollybrook (Lough Arrow).	Tributaries of Lough Arrow ...	—	—	18
Glencar	River Bonet, Glencar Lake and tributaries	14	7	22
Glenties	Lakes Dunlewy, Dungloe, Lough Veagh, Lough Divna and Drumleck Lough, Rivers Owenea, Crana, Stranacorkra, Ray, Clady, Gweebarra, Murlin	397	18	20
Inniskeen	Rivers Fane, Dee and Glyde, Lough Muckno	60	—	75
Drumconrath ...	River Dee	—	—	3
Blackcastle ...	River Delvin	—	—	2
River Brosna ...	Brosna System	—	—	60

APPENDIX No. 21—continued.

OUTPUT OF SALMON AND TROUT FRY, 1955/56. (in thousands)

Lough Ennell ...	River Barrow and tributaries of Lough Ennell	—	—	361
Lough Owel ...	Lough Owel	—	—	129
Lough Sheelin ...	Lough Sheelin tributaries, Collooney District ...	—	—	125
Roscrea	Ballybay, Poulaphouca ...	—	—	4
	TOTALS ...	2,542	151	1,780

NOTE.—In addition to the output of fry recorded in the above table for the Lismore, Killarney, Glenties, Lough Owel and Lough Ennell hatcheries, the following quantities of eyed ova were despatched from these hatcheries to other stations and are included in the figures for the latter, viz., from Lismore, 392,000 salmon ova ; Killarney, 50,000 salmon ova ; Glenties, 72,000 salmon ova, and 127,000 sea trout ova ; Lough Owel, 312,000 brown trout ova ; Lough Ennell, 209,000 brown trout ova.

1,250,000 salmon ova were hatched at the Lisnatunny hatchery and portion of the fry was liberated in the River Finn.

An experimental trout farm has been established at Rosetown (near Newbridge, Co. Kildare) by North Kildare Angling Association where the fry, resultant from 25,000 brown trout ova, were reared to the fingerling stage before being released.

APPENDIX No. 22.

LIST OF SCIENTIFIC PAPERS, ETC., BY OFFICERS OF THE FISHERIES DIVISION PUBLISHED DURING THE YEAR 1956.

F. A. GIBSON. "Escallops (*Pecten maximus*, L.) in Irish waters". *Proc. R. Dublin Soc.* 27 (N.S.) No. 8, October, 1956.

———— "Further specimens of shads from Irish waters". *Irish Naturalist's Journal* xii, p. 109.

———— "Further specimen of Greater Weever *Trachinus draco* L." *Irish Naturalist's Journal* xii, p. 110.

F. A. GIBSON with R. H. BAIRD. "Underwater observations on Escallops (*Pecten maximus*, L.) beds". *Journal Marine Biological Association, Plymouth* 35 pp. 555–562.

ANN HEALY. "Pike (*Esox lucius*, L.) in three Irish lakes". *Proc. R. Dublin Soc.* 27 (N.S.) No. 4, February, 1956.

———— "Further specimens of Irish char *Salvelinus colii*, Gunther". *Irish Naturalist's Journal* xii, pp. 41–2.

———— "Specimen of dusky perch *Epinephelus gigas*, Brünnich from Irish waters". *Irish Naturalist's Journal* xii, pp. 74–75.

———— "A specimen of tench *Tinca tinca* L. from Lough Lein, Killarney". *Irish Naturalist's Journal* xii, p. 109.

———— "Fishes of Lough Rea, Co. Galway, Ireland". *Salmon and Trout Magazine* No. 148, September, 1956, pp. 246–250.

C. MCGRATH. "Inland fisheries and the engineer". *Trans. Inst. Civil Eng. Ireland* 82, pp. 51–79.

EILEEN TWOMEY. "Pollan of Lough Erne". *Irish Naturalist's Journal* xii, pp. 14–17.

———— "Trout of Caragh Lake, Co. Kerry, Ireland". *Salmon and Trout Magazine*, No. 147, May, 1956, pp. 112–119.

ARTHUR E. J. WENT. "The Irish drift net fishery for salmon". *Journal of the Dept. of Agriculture, Dublin* 52, pp. 131–145.

———— "Recent records of species of fishes rare to Irish coastal waters". *Irish Naturalist's Journal* xii, pp. 68–70,

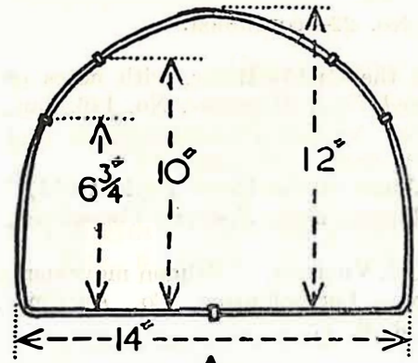
APPENDIX No. 22—continued.

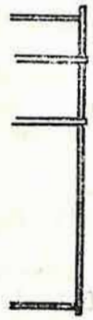
———— "Sea trout of the Cashla River, with notes on the salmon". *Salmon and Trout Magazine*, No. 146, Jan., 1956, pp. 63–76.

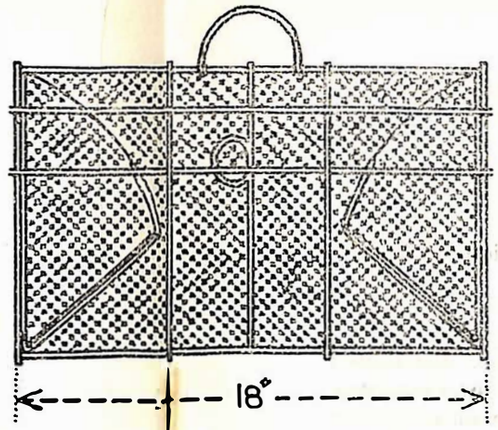
———— "Salmon of the River Foyle (1954)". Appendix IV, Fourth Report, *Foyle Fisheries Commission*.

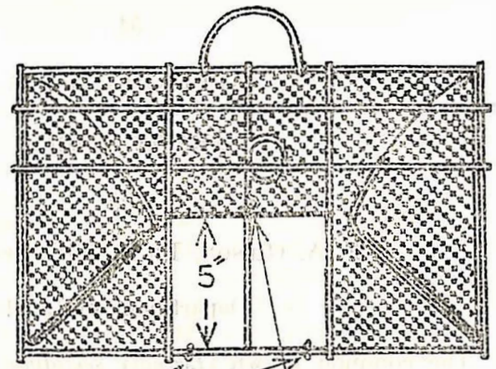
ARTHUR E. J. WENT with K. U. VICKERS. "Salmon movements around Ireland—vi. from Portballintrae, Co. Antrim". *Proc. Roy. Irish Acad.* 58 B. 2.

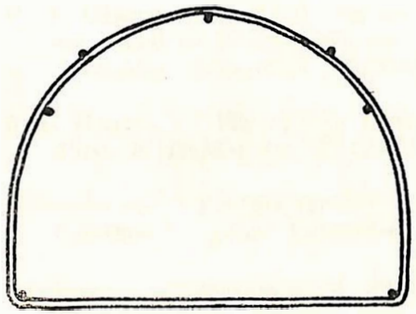
———— "Tagging programme, 1955". Appendix III. *Fourth Report, Foyle Fisheries Commission*.

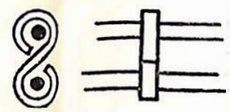


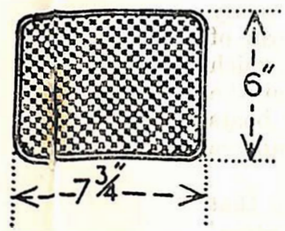


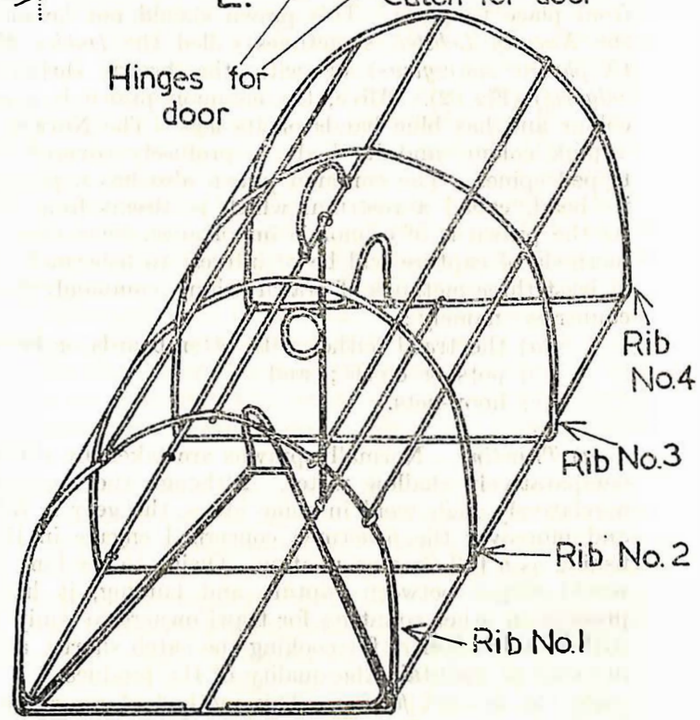


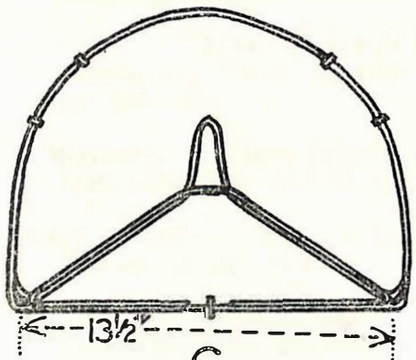


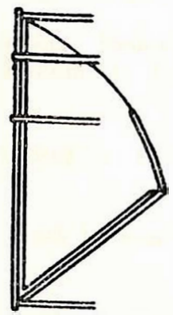












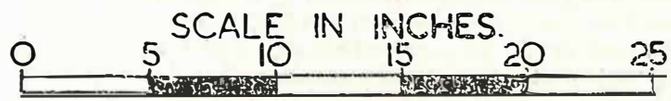


Fig. 1. Diagram of the construction of a prawn creel:

A—Ribs Nos. 1 and 4. B.—Ribs Nos. 2 and 3. C.—End view showing lead in.
D.—Elevation left side. E.—Elevation right side. F.—Isometric drawing entire creel.
G.—Plan and elevation of hinge. H.—Door. I.—Detailed side view of entrance and Rib No. 1.

APPENDIX No. 23.

PRAWN FISHING

By

F. A. GIBSON, PH.D., Fisheries Division

Department of Lands

The common prawn (*Leander serratus*) is widely distributed around the Irish coasts, but obviously varies in abundance from place to place. This prawn should not be mistaken for the *Norway Lobster*, sometimes called the *Dublin Bay Prawn* (*Nephrops norvegicus*) or with the brown shrimp (*Crangon vulgaris*) (Fig. 2). Alive, the common prawn is a grey-brown colour and has blue bands on its legs. The Norway lobster is a pink colour, and its body is profusely covered with white tipped spines. The common prawn also has a projection from its head, called a rostrum, which is absent from the shrimp. As the prawn is of economic importance, some notes on simple methods of capture will be of interest to fishermen. There are at least three methods of prawn fishing, commonly used in other countries, namely :—

(*a*) the trawl (either with otter boards or beam) ;
(*b*) pots or creels ; and
(*c*) hoop-nets.

(*a*) *Trawling*.—Normally prawns are taken by this method in comparatively shallow water. Although the method produces a relatively high yield in some areas, the gear is rather costly and moreover the fishermen concerned engage in this form of fishing as a full-time occupation. Owing to the long time which would elapse between capture and landing, it has been the practice in other countries for trawl owners to equip their boats with suitable boilers for cooking the catch shortly after capture in order to maintain the quality of the produce.

(*b*) *Pot or creel fishing*.—This method of prawning, like that by the hoop-net described later can, unlike trawling, be carried on as a part-time occupation which allows a fisherman to engage in other forms of fishing and other work generally. Creels made of close-woven wicker work, and shaped like miniature lobster creels, have now been largely superseded by square or rectangular wire framed mesh-covered pots and similarly constructed creels. Both pots and creels are most efficiently fished in groups or trots (Fig. 3). Each trot usually consists of a dozen pots or creels which are attached at 3 or 4 fathom intervals to a bottom rope. It is a wise precaution to anchor both ends of the trot rope when fishing on exposed shores, though it is unnecessary to do so in quiet inlets. A buoy-line is attached to one or both

ends of the trot rope. It is also a wise precaution to attach the buoy-line by a swivel to the trot line anchor, where strong tides run, in order to avoid fouling and consequent shortening of the buoy-line. A commercial fleet of pots or creels usually comprises between 6 and 8 trots, for which a boat of at least 20 ft. is required, if the fleet is to be handled with comfort. The design of a prawn creel is shown in Fig. 1. The creel rather than the pot is described in this figure, because it was found by experiment in Irish waters that the creel is slightly more efficient than the pot. It is imperative that the mesh covering the creel frame must not be greater than $\frac{3}{8}''$ in diameter. If the mesh is smaller, say $\frac{1}{4}''$ it will be found to capture the tiny prawns, which will cause difficulties when the catch is being handled and sorted. Furthermore, there is a tendency, with too small a mesh, towards reduced catches of marketable prawns. The typical ground where prawns are found is on the sand and mud patches of the foreshore between rock outcrops and surrounded by the large oarweed at the low water mark. Prawns will also be found commonly where eelgrass is re-appearing. It is advisable to fish creels as near to the large oarweeds as possible, without being covered by them. If creels are fished every four hours from dawn to dusk, it will be found that the catches during the hours of daylight are poor and that best returns are obtained at or before dawn and at or after dusk. For this reason, it will be found economical to set the creels in late evening, pick them up shortly after dark, reset them on the same grounds and fish them again at or preferably just before dawn. After the dawn fishing the creels are normally taken ashore for cleaning and rebaiting.

The most successful bait appears to be crushed green shore-crab. It is relatively easy to capture large quantities of shore crabs by baiting with waste fish an old crawfish pot to which a smaller eye has been fixed, or some similar kind of trap. If the baited trap is placed amongst the brown sea-weeds of the middle shore line, large quantities of green crabs are likely to be captured the quantity depending, of course, on the state of the tides. The bait crab, should be crushed so as to expose the coral and meats of the legs. Overcrushing should be avoided because the best of the bait may be washed out of the creel when setting. Other successful baits include salt-herring and gurnard, flat fish heads, limpets and mussels. None of these, however, has been found to be as good as green crab. The crushed crab, or other small bait, can either be tied in a shrimp-net bag and suspended from the eye in the upright in the middle of the creel (Fig. 1), or broadcast on the floor of the creel. The confinement of the bait in a shrimp net bag has the advantage of allowing it to be used at least twice, and thus avoiding too much re-baiting. On the other hand, there are grounds for stating that when the bait is broadcast on the bottom of the creel larger catches of prawns are likely.

(c) *Hoop-net.*—The hoop-net (Fig. 4) is constructed from a light metal or wire hoop, 3 feet in diameter, to which a cone shaped shrimp netting bag is lashed. The depth of the bag should not exceed 3 feet. Each hoop-net has three bridles which meet to form a buoy-line of the length required to fish the nets in not more than 5 fathoms of water. Across the diameter of the hoop-net a baiting string is attached to which salt herring, gurnard, plaice heads, etc., are secured by a slip-knot. The advantages of the hoop-net are (1) cheapness, and (2) the number of nets which can be carried. A small row-boat will take up to 50 hoop-nets, stowed one on top of the other on the stern sheet. When each net has been baited prior to setting out for the grounds it is laid upside down with the corks and buoy-line underneath. This greatly facilitates shooting a large number of hoop-nets stacked one on top of another. Hoop-nets are best fished on the same type of ground mentioned for creels, usually at or after dusk. Each hoop-net should be shot 4 to 6 fathoms apart. When the last net has been shot, the first one can be picked up. Each net need only be left fishing for a period of 10–20 minutes. Taking up the buoy-line, the net must be raised with great care off the bottom, and, when a fathom or so of the line is boarded, the remainder of it should be hauled in as rapidly as possible. More than one fishing can be made each night, though this and the extent of the catch will depend upon the clemency of the weather.

Handling the Catch.

The handling of the catch is most important, if the prawns are to reach market in good condition. Prawns cooked after their death do not take on the typical bent condition and bright pink colour associated with those cooked alive. For this reason, and to avoid losses, it must be borne in mind that the prawns must be cooked as soon as possible after their capture. The catch must not be placed in a container of water during the actual fishing operations, because prawns use up the oxygen rapidly, foul the water, and die quickly. They will live longer out of water, and may, therefore, be placed in an ordinary fish-box lined with sea-weed and covered with a clean moist sack. This will protect the prawns from the adverse effects of light or drying.

It is not always profitable to cook the catch of each night's fishing as it is landed. Prawns may be stored for periods up to 7 days, in keep-boxes floated in clean undiluted sea water. Undue loss may result from fresh water, either run-off from the land or as rain, or harbour bilge entering the box. A suitable box measures 36 ins. × 18 ins. × 6 ins., and the long sides of the box are cut away and covered with $\frac{1}{8}$ ins. woven wire. This allows water to circulate amongst prawns stored in the box, whilst access to the prawns can be gained by a lid arrangement on the top. Floated in satisfactory water each box will hold up to

3,000 prawns (say, about 20–24 lb. weight). Prawns should not be fed whilst stored in these keep-boxes. A good morning and night fishing by creels should yield between $\frac{1}{2}$ and 1 lb. weight of prawns per creel. The nightly catch from hoop-nets is usually slightly less per net.

When sufficient prawns have been collected for a shipment to market they should first be boiled in fresh water, to which $\frac{3}{4}$ of a cup of common salt has been added for every 2 lb. weight of prawns. Prawns are probably best put into the boiling water. After boiling for a few minutes, the prawns will rise and a froth or " lett " as it is called appears. This froth should be skimmed off so that the prawns settle again. They rise for a second lett at which point they are properly cooked. The prawns should then be left out to cool. After cooling they should be washed with fresh water to remove any attached scum, etc. Prawns are best packed in small boxes or punnets. The bottom of the container should be liberally sprinkled with salt, and filled with alternate layers of prawns and salt at the rate of about 5 lb. of prawns per layer. The salt will keep them fresh during transport in hot weather.

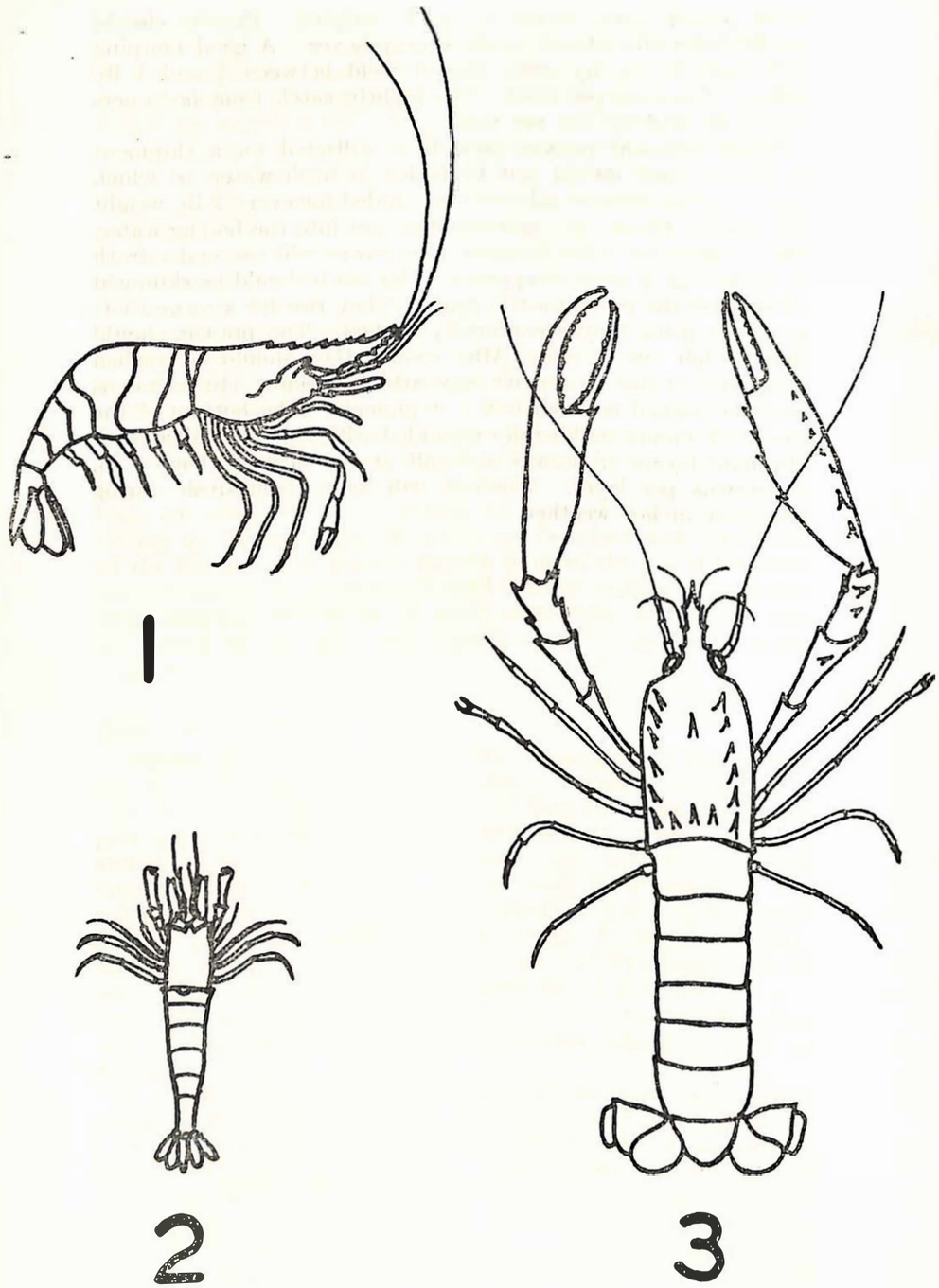


Fig. 2. Three types of shellfish :
1—The Common Prawn.
2—The Brown Shrimp.
3—The Norway Lobster (Dublin Bay Prawn).

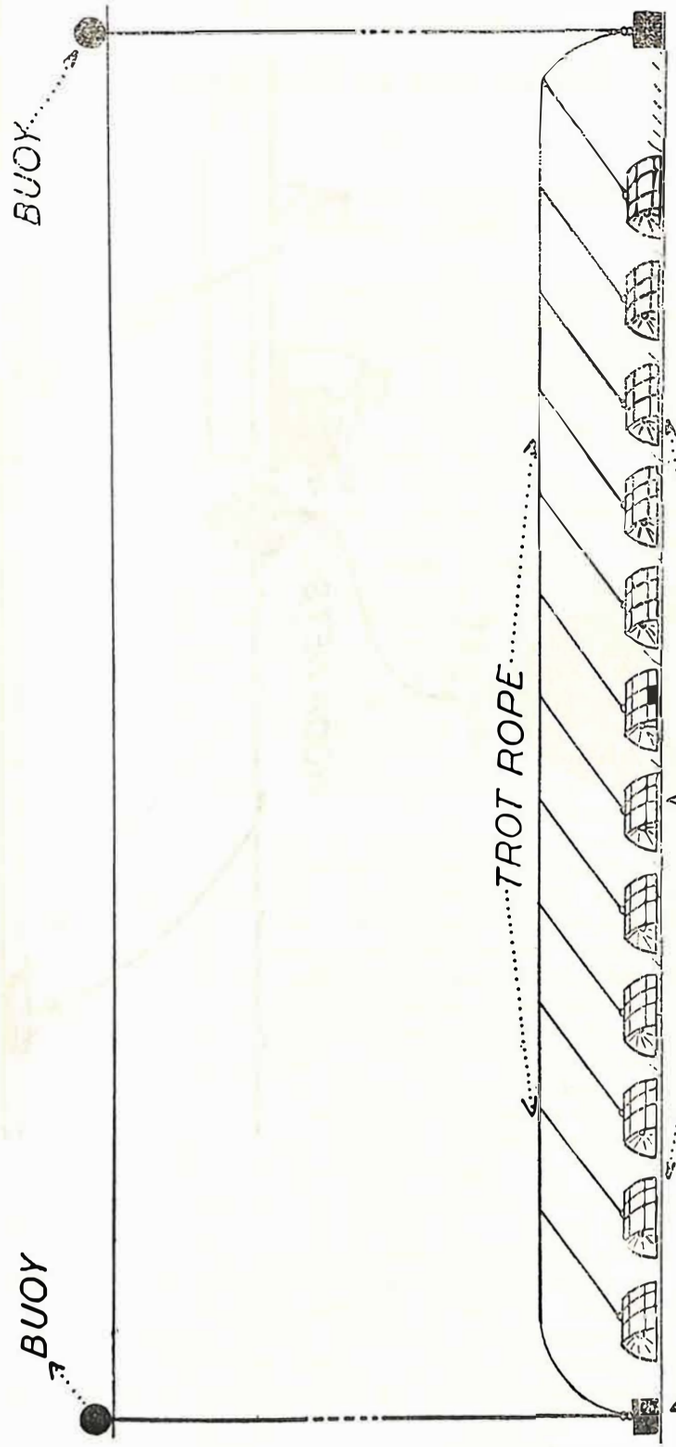


Fig. 3. Diagrammatic representation of the fishing position of a trot of prawn creels. Note the heavy anchors, which are advisable if fishing takes place on an exposed shore.

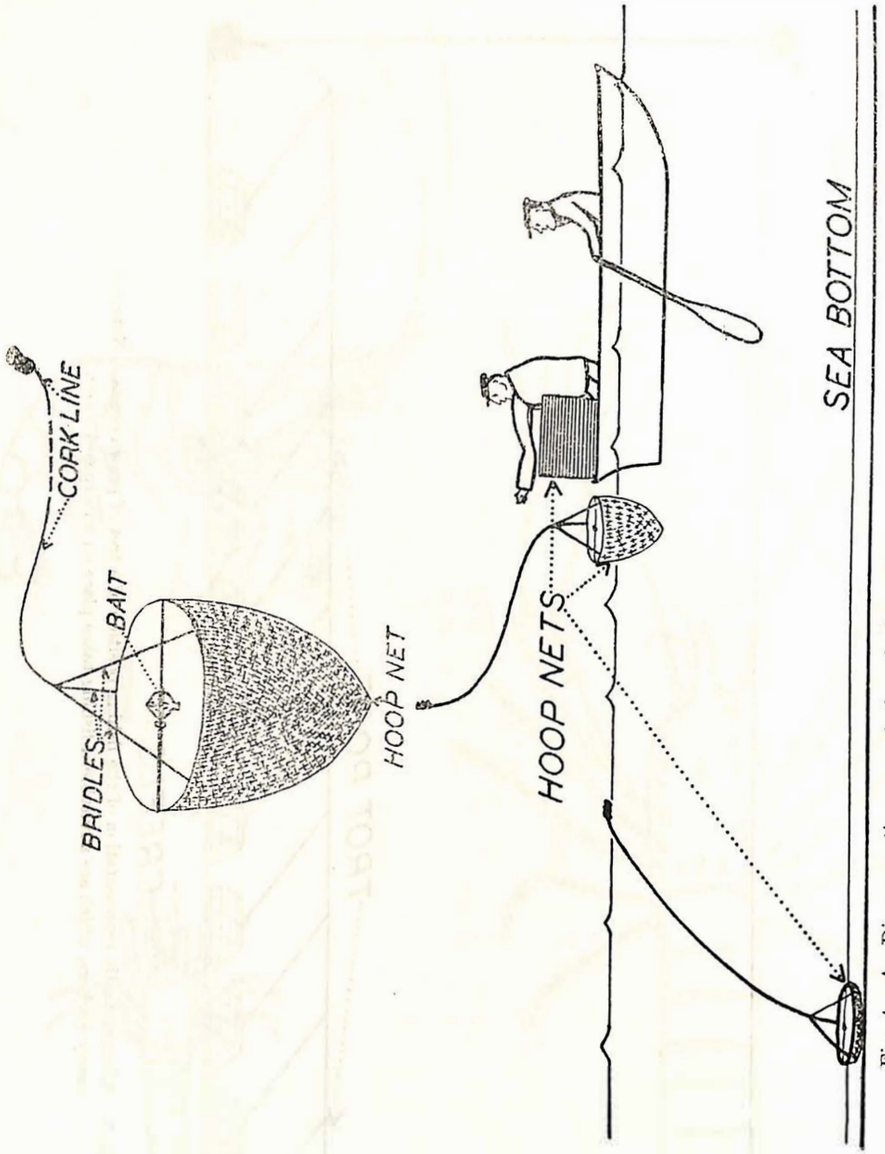


Fig. 4. A—Diagrammatic representation of a hoop net.
B—Method of stowing and shooting hoop-nets from a small craft.

APPENDIX No. 24.

SOME NOTES ON CRAB FISHING

By

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Specific fishing on a commercial scale for the edible crab is practised only to a limited extent in this country and, although fairly substantial quantities of edible crabs are landed annually, these are largely the by-product of creel fishing for lobsters and crawfish. These notes give a short account of certain crab fishing methods and record the results of some experimental fishing undertaken by the Fisheries Division.

The edible crab is familiar to most fishermen, who recognise it by its dark red topside coloration and yellow underside and thus distinguish it from the smaller green shore crab and the blue swimming crabs. Edible crabs abound in sandy patches and rocky weed-strewn areas in water depths varying from a few to over thirty fathoms. Whilst crabs may be captured at all times of the year, their suitability for market at any particular time will be governed by the condition of their reproductive organs. Normally, if the reproductive organs are well developed, the meats of the crab will be in good condition. Reproduction in crabs varies greatly from place to place and year to year but a generalised description of the reproductive cycle is as follows. Crabs spawn during the winter months, and in doing so migrate to deeper water, usually further offshore. Once they have spawned, their edible parts are in very poor condition and the meat content is very low. At this stage, they are commonly called "black-sick" crabs. When spawning has ceased, crabs recommence to feed actively and move slowly from the deeper offshore waters to the shallower depths inshore where suitable feeding is found normally in abundance. The jack-crabs (males) may reach the inshore waters earlier than the hen-crabs (females) and generally their rate of recovery from the effects of spawning is faster than that of hen-crabs. In certain areas, there can, therefore, be a fishery primarily for jack-crabs during the late spring and early summer months. As summer progresses, so increasing numbers of hen-crabs reappear in inshore waters and ordinarily they are for the greater part in good condition by mid-July reaching their best in the autumn months. On the whole, crab fisheries can normally be expected to reach their highest level of production in the autumn although the fishing season may extend from April to November. This being only a general synopsis of the behaviour and movements of crabs, it must be realised that considerable differences occur as between one locality and another under the influence of annually varying

conditions. Crabs appear to be strongly affected by their environment and the type of feeding in it. For example, if summer climatic conditions inshore are sub-normal resulting in the return of the inwardly migrating stocks to unfavourable feeding grounds, their rate of recovery is drastically slowed and a reasonably good crab fishery may not become available until the late autumn or early winter months, in which case the inshore fishing grounds may have to be temporarily forsaken for those further offshore and in deeper water.

According as the hen-crabs improve in condition, they develop a bright red " coral ", at which stage their market value is highest. For both hens and jacks the following simple procedure will enable any fisherman to assure himself whether his crab catch is suitable either for sale in the shell or for processing. Take, at random, about 3 dozen crabs from the day's catch. Place them in water to which 10% salt has been added and boil for 25 minutes. Then open the crab " box " (i.e. break away the shell from the crab's back). If the " box " is full and its contents are of a reddish brown colour and fairly dry and solid, then the crabs are fit for sale in the shell or for processing. If the " box " is only half full, and the contents are grey-green in colour, and soft or liquid, then the crabs are not suitable for sale for processing, and are below quality for sale in the shell. With experience it is possible to tell by the look and the " feel " of crabs their suitability for marketing in the fresh state or for processing but the above simple test enables the fisherman to resolve his doubts readily.

Methods of Fishing.

(1) *Type of Boat.*—No hard and fast rules for the type of fishing boat to be used for crab fishing need be laid down but for economic working it is considered that it should be capable of fishing from five to seven dozen crab creels at a time.

(2) *Type of creels.*—Various types are used including the two-eyed and parlour (both British), and the Nova Scotian and Norwegian crab creels, as well as crawfish creels of French design. With the exception of the last two mentioned, all these have a slotted wooden base to which a varying number of hoops are fixed, to form a framework upon which a sizal net covering is stretched. The openings or eyes are positioned through the netting. Normally, the creel bases measure a minimum of 30 by 20 inches and consist of approximately four $\frac{3}{4}$ to $\frac{7}{8}$ inch thick wooden laths, lashed together by four strong cross-laths. Usually four hazel or ash saplings, about 1" thick, are firmly affixed to the creel base in the form of Ω-shaped arches, and these are lashed together by slender cross laths. In some cases a roof is made by affixing about ten narrow laths spaced about 1" apart longitudinally along the upper parts of the arches. This roof strengthens the creel so that less damage is done to it during stacking, and less repair work is involved. Sometimes a split,

which can be laced together, is selvedged in the netting on one side, and this serves as a door through which baiting and removal of the catch can be carried out. Alternatively, a separately constructed door is made in the netting, or in the timber roof, to allow free access to the creel. The position of the funnel shaped openings, or " eyes ", into the creel varies considerably with each type of creel. An eye may be placed at either end of the creel or opposite each other on the long sides or again diagonally opposed to each other on this side of the creel. There may also be an eye at one end of the creel, and a further eye within the creel leading to a separate compartment or parlour. In the Nova Scotian creels three such eyes lead into one compartment, through any of which crabs pass through an inside eye leading directly to the parlour, where the bait is located. The construction of these eyes varies also. In some cases the funnel leading to the eyes commences at the edge of the long end of the creel and the eye itself consists of a metal ring to which the funnel netting is lashed. There may be no funnel shaped lead-in and instead a larger metal ring may be fitted flush with the outside netting, to which a funnel is knitted and which leads to a smaller affixed metal ring through which crabs enter the creel. In other instances the funnels are not supported by rings, but merely consist of shaped netting held extended within the creel by anchoring twines. In the case of the Norwegian creels, the funnels are constructed of narrow laths of timber, while in the French crawfish creel a square or circular shaped opening is situated on the topside of the creel. Both the Norwegian crab creel and the French crawfish creel have no base and are constructed in the form of barrels, using cross laths and lashing hoops, the whole framework except the eyes being covered with sizal netting. The ends of the French crawfish creel are constructed of separate heavy-gauge woven wire frames, which greatly reduces the damage caused to the rest of the framework during fishing and storing.

The object of the experimental fishing carried out, was to make comparative tests between the types more commonly in use, namely the French crawfish creel and the diagonally opposed two-eyed crab creel of British type. The concensus of opinion of fishermen is that certain creels, with their own peculiar virtues, are best suited to particular areas. Therefore, whilst this work later on favours the use of the former type of creel over the other on the results of the trials carried out, all the chief types of creel have been described above in order that fishermen may be able to try them out, with or without modifications, should either of the two types considered not prove fully suitable to local conditions.

(3) *Bait.*—There is a commonly held belief that fishermen should use " salt bait for lobster, and fresh bait for crabs ". Various baits including conger eel, gunner, rock connor, dogfish, etc., were used in experimental fishing, as well as salt baits,

The latter were not fouud to be successful, whilst no apparently significant difference was found to exist between the different fresh baits used. Suffice to say that almost any fresh bait will prove adequate. In some cases, fishermen contend that it should not be possible for the captured crabs to eat the bait because they claim that, if all the bait is consumed, crabs may find their way out of the creels before they can be fished. If the bait is covered so that it cannot be taken readily, it may have the effect of retaining the catch within the creel over longer periods so that less creel-lifts have to be made each day. On the other hand, it is possible that a covered bait will either not attract as many crabs to it as an uncovered one, or actively feeding crabs finding that they are unable to obtain a full meal from it may leave the creel in search of more readily obtainable feeding. Therefore, to fish the creels most efficiently, the safest method is to fish them often, and bait them as required, whether the bait be covered or not.

(4) *Choice of Fishing Grounds.*—Experience alone will guide the fisherman in his choice of fishing grounds, bearing always in mind that the later the season up to August the shallower the water depth to be fished, and thereafter the deeper the water to be fished, generally speaking. As a rule, it is advisable to set the creels on mixed bottoms consisting of rocky outcrops interspersed with clear patches of ground. Creels may either be set individually, or in strings the numerical composition of which is a matter of choice but is generally a dozen per string. The latter method of setting them is advised, for, whilst it entails a considerably greater amount of care, it calls for less operations than are involved in individual setting which of itself increases the efficiency of fishing. The creels are lashed to a strong back rope on runner ropes about 3 fathoms long, at intervals of about 10 fathoms. The back rope may be anchored at one or both ends, so that the position of either or both ends may be determined by a buoyline. It is advisable never to shoot the creels against the run of the tide. Although it is most convenient to shoot the creels with the tide, for the experienced fishermen perhaps the best positioned setting will be obtained by shooting the creels across the tide, care being taken to avoid fouling the back line in the screw. The hauling of creels is best done with the tide, and the use of two buoylines can thus be seen to be advantageous because it allows hauling to commence at either end. A small roller placed in the gunwale astern will greatly facilitate manual hauling of the creels. The creels are allowed to remain attached to the back rope, and are stacked in rotation aboard ready to be shot. It is advisable to take each string of creels aboard for removal of catch before baiting, where necessary, and re-shooting.

(5) *Handling the Catch.*—It is not always possible to catch enough crabs to make up a daily consignment for market nor are suitable local transport means available in all places to

enable consignments to be handled daily. In such cases, storage boxes can be quite simply constructed for holding the crabs but the important factor to remember is to give them as little space for movement as possible. If they are allowed to move freely in a small area they will inevitably fight with each other with resulting mortality. If, therefore, the crabs available do not fill a storage box, it is advisable to pack the box with weed in order to restrict the crabs' movements. A simple storage box can be constructed from a reinforced, standard fish box, or other box of similar dimensions. Only when large quantities of crabs are being caught, need large storage boxes be constructed. Ordinarily, it will be found more convenient to have a number of small storage boxes than to have one large storage box. The sides of the storage box should be regularly perforated at 2″ intervals by 1″ holes. The reinforced lid, should either be hinged or be capable in some other way of being very firmly kept in position. These storage boxes should be anchored, preferably afloat, but always away from any source of freshwater or harbour bilge. Crabs can be stored in this way for 48 hours without undue loss, but thereafter mortality progressively increases. Stored or freshly caught crabs can be despatched to market or for processing, firmly packed either in fish boxes or small barrels. The crabs are laid legs downwards on top of each other and when they have been allowed about half an hour in which to settle down into wedged positions, any spaces left can be filled in by additional crabs or sea-weed, but in such a way that slight pressure only will be required to fit the lid of the fish box or barrel firmly into position. The boxed or barrelled crabs should be kept in a cool place and despatch so organised that the shortest possible time will elapse between their removal from the storage boxes and their arrival at destination.

Results of Experimental Fishing.

The following results of experimental fishing for crabs carried out by this Department with the assistance of local fishermen afford some indication of the order of the catches that may be expected from crab fishing.

Initial experiments were promoted on the South coast (West Cork) in 1955. Thirty-six two-eyed creels of the British type were used and from mid-July until the first week in November they caught a total of 790 dozen crabs (weighing approximately 790 stone) of which over 60% were landed in October. The period included much broken weather with equivalent loss of fishing time ; the yield averaged just over 21 stone of crabs per creel for the period and amounted to 12 stone per creel for October. The crabs were of uniformly good quality, and consisted of an almost 50/50 distribution of jack and hen-crabs. Further tests carried out on the Co. Cork coasts in April, 1956, were somewhat unproductive, due probably to the earliness of the time of fishing. In June, 1956, fishing trials were carried

out off the Co. Waterford coast. Only salt baits were used, and this factor may have influenced the small yield obtained. Subsequent to the Department's experiments in this area, good catches of crabs were made by fishermen there. These catches were made up of crabs obtained in lobster and crawfish creels, whilst fishing primarily for the latter species. In July, 1956, a further series of tests was conducted off the West coast (Connemara area). In this case two-eyed crab creels of British type and French crawfish creels were fished against each other and tests for significance of the efficiency of different fresh baits were made. The creels were hauled at least twice per day, and especially in the early morning and late evening. Hauls made at intervening times indicated clearly that the most profitable return was from creels lifted at three hourly intervals. A total of 12 British creels was fished against 4 French crawfish creels in two strings of 8 creels each, upon which the two kinds of creel had been randomly distributed. A total of 20 fishings were made, involving 320 creel lifts, from which 556 crabs were produced, weighing a total of 648 lbs. (just over 46 stone for 46⅓ dozen crabs). This is just under two crabs per creel per haul. While this is not a very high yield per creel lift, it must be pointed out that it is an average figure obtained during broken weather when a number of fishing days were lost and the daily yield per creel lift varied from nil (when conditions would not allow creels to be lifted) to 64 on the best day of fishing (a rate of 4 crabs per creel lift). A commercial fleet of crab creels (60 creels) on the basis of these average yields could be expected to yield at least 10 stone of crabs per haul. There was no significant difference between the size or weight of crabs caught by the French or the British creels. The slightly better catches made by the French crawfish creels could not be regarded as sufficient certainty against the results having been obtained by chance only. On the basis of the experiments there is not strong enough evidence to suggest that French crawfish creels are more efficient crab fishing engines than the British creels, though experience has shown clearly that they are much easier to handle. Results from the catch of crabs, using fresh conger eel, rock connor, dogfish and crushed edible crabs as bait showed little difference in efficiency between them. When due allowance had been given to all water factors involved, viz., calm, choppy, rough, etc. it was concluded that the catch in calm weather was slightly above average. So far as this work shows, therefore, the chief way in which the French crawfish creels can be said to be more efficient, is in the ease with which they can be handled, *i.e.*, for storing, baiting and removing the catch, and on that basis they may be more generally favoured. They have, moreover, the added advantage that properly baited they can be employed in fishing for lobsters and crawfish when not required for crabbing.

APPENDIX No. 25.

ROACH AND DACE IN THE CORK BLACKWATER

By

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Department of Lands.

1. Material consisting of scales, measurements, weights and stomach contents of roach and dace from the Blackwater River provided the basis for this investigation.

2. Two types of rings were found on the margin of the roach scales (all of which were collected in May) namely (*a*) a band of narrow rings and (*b*) a band of wide rings. The band of narrow rings would appear to be laid down on the dace scales in May.

3. The majority of the roach and dace examined were 5-year-olds.

4. Some male roach and some male and female dace spawn at the end of their second year of life.

5. The average lengths age for age of the dace were far greater than for the roach.

6. The length/weight relationship of the dace (average value of $K = 0 \cdot 98$) is far inferior to that of the roach (average value of $K = 1 \cdot 15$).

7. Roach would appear to feed more on plant food than dace.

Roach (*Rutilus rutilus*) and dace (*Leuciscus leuciscus*) are found only in the Cork Blackwater in Ireland. Went (1950), in his "Notes on the Introduction of some Freshwater fish into Ireland" gives information on these two species in Irish waters as follows:—

> About the year 1889 a Mr. Logan used to fish for salmon in the Blackwater. His Secretary, Mr. J. C. Truss, came over from England to fish for pike and brought two cans of mixed roach and dace for bait. He left the two cans tied with two cords by a wall going down to the river. The cans were swept away by a flood and were found empty the following summer a mile below where they were placed. About two years afterwards the fish were first noticed in the river. Mr. John O'Brien of Ballyduff, Co. Waterford, who was ghillie to Mr. Truss, himself a very old man gave evidence on these lines at an enquiry in Lismore, Co. Waterford, on 4th June, 1940, to the late G. P. Farran, Inspector of Fisheries.

Since this time the dace particularly have thriven in this river. They have ascended most of the tributaries in and around Fermoy. They are found in the main river as far west as Millstreet (which is approximately fifty miles from the original stocking) and east to beyond Cappoquin. They are present even in the main tidal tributary, the Bride.

The dace in the Blackwater and its tributaries are now regarded as a menace by the trout anglers and ways and means are being planned to reduce them. Roach though plentiful are not regarded as such a pest since they normally do not rise to a fly.

The Inland Fisheries Trust Inc. in conjunction with the Fisheries Division of the Department of Lands used battery powered pulsed D.C. electrical fishing equipment to get samples of roach and dace in the Funshion River, a tributary of the Blackwater. About one mile of the river above and below Kilworth bridge was fished systematically on May 31st, 1956. A total of 186 dace and 137 roach were netted.

The fish were examined in the following manner :—Firstly, the length of the fish was measured from the tip of the snout to the end of the longest caudal fin rays and its weight recorded. Secondly, some scales were taken from the shoulder of the fish. Thirdly, the sex and condition of the gonads was determined by internal examination and finally the stomach contents of a random sample of the fish were preserved for later examination.

1. Roach.

Three different variations in rings were found at the edge of the roach scales which were all collected in one day (*a*) those with a narrow band of rings on the margin, (*b*) those with one or two wide bands on the margin and (*c*) those with 7, 8 or more wide bands on the margin. In grouping these fish for age, length and weight determination (*a*) and (*b*) were classed in the same age group and (*c*) were put in a higher group since it was obvious that the next narrow band was about to be laid down on these scales.

Jones (1953) did a detailed study of some 2,000 British roach. He describes two types of rings on the scales namely, (*a*) a narrow band of rings and (*b*) a wide band of rings. In addition he refers to erosion on some scales which appears during or after the formation of the narrow band of rings. He found that erosion was present only on the scales of ripe or spent fish, and could thus be definitely regarded as a spawning mark. He also states that the degree of erosion varies considerably in individual fish and that often it is very slight.

The wide and narrow band of rings are quite evident on the scales of the Funshion roach but erosion was visible only in eleven out of a total of 137 sets of scales despite the fact that the majority of the roach examined were spawning or spent fish. In the Funshion erosion was present on the scales of nine spawning and two spent fish of which seven were males and four females. The first erosion on the scales of both males and females was evident at the end of the third year of life except for two male fish which had erosion on the scales at the end of the second year. Hence it would seem that some males spawn at the end of their second year and some females at the end of their third year of life (this was also evident from gonad examination).

The numbers of fish examined in the various age groups were as follows :—

Age Group	Number
*3	37
4	18
5	33
6	32
7	2
8	4
9	9
10	2
Total	137

*3 group includes fish 3-years old and upwards but less than 4.

The average lengths of the fish in the different age groups are given in Table 1 together with the average lengths from some British and Continental waters for comparison. The fact that the Irish fish were measured to the tip of the tail (the British fish were measured to the fork) would account to some extent for their greater lengths but even allowing for this difference the growth rate of the Irish fish is of the same order as the fastest growing British and Continental fish.

As may be seen from Fig. 1, the greatest frequency of occurrence was from 19 to 22 cm. which indicates that the majority of the fish were 5 or 6-year-olds. The peak at 16–18 cm. would denote that 3-year-old fish were the next most important age group.

The length/weight relationship may be seen in Fig. 2. The curve represents the average weight plotted against the average length for the different year classes. It can be seen from this Figure that the roach gain quickly both in length and weight between seven and eight years old. Strangenberg (1956) noted a great increase in length and weight between the seventh and eighth year of life for roach in Goplo lake, Poland.

The Condition Co-efficient (K) or length/weight relationship was determined according to the formula $K = 10^2W/L^3$ where W = weight in grams and L =length in centimetres. The average values for the different age groups were as follows :—

Age Group	3	4	5	6	7	8	9	10
K	1·12	1·12	1·15	1·18	1·12	1·26	1·13	1·22

with an average value of 1·15 for all fish. It would seem that the condition of the roach in the Funshion is very good when compared with that of the dace whose average value for April was 0·79, May, 0·93 and June, 0·98, respectively. Some allowance must be made for the fact that all the dace examined

were spent fish, whereas the majority of the roach were spawning fish.

The sex of 136 fish was determined by internal examination and the condition of the gonads may be seen in Table 2. Even though the numbers involved are small it would appear that the males are more numerous in the lower age groups and the females in the higher groups. It is also evident that 88% of the 3-year-old males were sexually mature whereas 70% of the 3-year-old females were sexually mature. Jones (1953) found spent males in the 2 group (3rd year of life) and spent females in the 3 group (4th year of life). Hartley (1947) found that at least 50% of the one-year-old males were mature and 88% of the three-year-old males were breeding fish. He found an occasional two-year-old breeding female and at 3 years old he noted that three out of every four roach were spawning fish. It would seem that the roach of the Funshion spawn about the end of May. It is not possible to give the extent of the spawning season as the only samples collected were taken at the end of May.

The stomach contents of sixty-four fish taken at random were examined and the nature of the food in the various length groups was determined (Table 3). There would not appear to be any significant differences in the food of the various length groups. Chironomid larvae, caddis larvae, higher plants and algae make up the bulk of the food of fish from 3 to 10 years old. Hartley (1940) found that the food of the roach from four different localities in Britain was predominantly vegetarian, with crustaceans second in importance and insects third. He states that crustaceans and diatoms are, on the whole, the food of smaller fish, and that molluscs are eaten by larger roach. He also mentions that insects, higher plants and algae are eaten consistently throughout life which would also appear to be the case with the Funshion roach.

In Goplo lake, Poland, Strangenberg (1956) found higher plants in all the age groups from 3 to 10 years of age. Molluscs were also present in all these age groups but were more prevalent in the stomachs of older fish where the percentage of higher plants decreased or was absent altogether.

2. Dace.

A total of 288 dace were taken in a draft net at Lismore in June, 1941; anglers captured 34 fish at Ballyduff on April 29th, 1956, and as mentioned previously 186 dace were taken by electricity from the Funshion on 31st May, 1956.

Two types of rings were found on the margin of the dace scales namely (*a*) a band of narrow rings and (*b*) a band of wide rings. The band of narrow rings would appear to be laid down on the dace scales during the month of May. All scales examined from the fish caught in April had a band of wide rings on the margin; the majority of those taken at the end of May had a

band of narrow rings on the margin and a small percentage showed one or two wide rings on the margin. All scales from the June sample had a band of wide rings on the margin. The band of narrow rings is not a spawning mark since it was not present on the scales in April when all fish taken were spent. No erosion was visible on the dace scales examined.

The numbers of fish examined in the different age groups were as follows:—

Age Group	Net	Rods	Electricity
0	—	—	1
2*	3	2	6
3	19	25	97
4	68	6	39
5	108	1	29
6	66	—	7
7	18	—	5
8	5	—	1
9	1	—	1

*Included in this group are 2-year-olds and upwards but less than 3.

The majority of the fish taken on rods and by electricity were three-year-olds whereas five-year-olds predominated in the net caught samples. As may be seen from Fig. 3 most fish occurred in the length groups from 23 to 26 cm. with a peak at 25 cm. indicating a predominance of 5 and 4-year-olds respectively. The other lesser peak at 22 cm. corresponds to the 3-year-olds the next most important age group.

The average lengths and weights of the various age groups for the three months are given in Table 4 and as will be seen fish of the same age were longer and heavier in June than those taken in May which would suggest that the June fish had fully recovered from spawning. The average lengths of the Blackwater fish are much superior to those obtained by Hartley (1947) for the River Cam and its tributary the Shepreth Brook, even allowing for the fact that Hartley's fish were measured to the fork, whereas the fish in the present investigation were measured to the tip of the tail.

In Fig. 4 it may be seen that the average lengths age for age of the dace are much superior to those for the roach. The growth of both species would appear to be fairly steady, the results for the older fish not being significant owing to the small numbers involved.

The Condition Co-efficient (K) or length/weight relationship was determined according to the formula $K = 10^2W/L^3$ where W = weight in grams and L = length in centimetres. The

average value of K for the various age groups for the different months was as follows :—

Age Group	April	May	June
2	0·73	1·04	1·03
3	0·78	1·04	1·00
4	0·81	1·04	0·99
5	0·85	1·00	0·98
6	—	0·98	0·99
7	—	0·84	1·01
8	—	0·76	1·04
9	—	0·78	0·95

The average values of K for April, May and June were 0·79, 0·93 and 0·98, respectively. Hence it would seem that dace are in poor condition in April after spawning, they have recovered somewhat in May and they are in good condition in June. The roach in the Blackwater would appear on the whole to be heavier length for length than the dace.

The sex of 482 fish was determined and 61% were males. The percentage of males and females in the different age groups was as follows :—

Age Group	Males	Females
2	72	28
3	60	40
4	63	37
5	65	35
6	65	35
7	31	69
8	17	83
9	—	100

As in the case with the majority of coarse fishes the males are more numerous in the lower age groups and the females in the higher groups. Of the 151 fish examined by Hartley (1947) from the River Cam 54% were females. As all the 2-year-olds examined were spent fish it would appear therefore that at least some males and females spawn at that age.

The stomach contents of 34 fish taken in April and 75 fish caught in May were examined. The nature of the food in the different length groups for the two months is given in Table 5. The food of the fish from 15 to 30 cm. in length consisted mainly of insects, of which chironomid larvae predominated. In the 15–20 cm. group *Simulium* sp. larvae were next in importance. Chironomid pupae and caddis larvae though frequently eaten, did not predominate in the diet of any fish. Diatoms were dominant in the food of only one fish and algae were present

in three. In the 20–25 cm. group algae were next in importance to chironomid larvae and *Simulium* sp. larvae, caddis larvae and Mayfly nymphs were eaten in large numbers. Diatoms, though frequently eaten by fish of this length group did not predominate in the diet of any fish. In addition to chironomid larvae fish in the length group 25–30 cm. fed on caddis larvae and *Simulium* sp. larvae. It would seem from these observations that the food of the dace in the Blackwater and its tributaries consists mainly of insects and some algae and diatoms. Hartley (1947), in the fish he examined found a change in diet with increase in size, the smaller fish feeding on large quantities of insects, diatoms with some other plant material and larger dace on snails, insects, freshwater shrimps and plants.

REFERENCES.

HARTLEY, P. H. T. (1947). The Natural History of some British Freshwater Fishes. *Proc. Zool. Soc. Lond.*, 117, 129–06.

JONES, J. W. (1953). The scales of Roach (Part I). Age and growth of the Trout, Grayling, Perch and Roach of Llyn Tegid (Bala) and the Roach of the River Birket (Part II). *Fish. Inv. Ser.*, 1, Vol. 5, No. 7, 1–18.

STRANGENBERG, M. et al (1956). The growth and the summer food of the economically most important fishes of the Goplo Lake. From the laboratory of Limnology and Fishery Zootechnical Department, College of Agriculture, Wroclaw. *Zoologica Polonia*, Vol. 7, No. 1, 88–96.

WENT, A. E. J. (1950). Notes on the Introduction of some Freshwater fish into Ireland. *Dept. of Ag. Journ.*, Vol. XLVII, 3–8.

TABLE 1.—Growth Rates of Roach from the Funshion and from some British and Continental Waters.

AGE GROUPS	0	1	2	3	4	5	6	7	8	9	10
Funshion	—	—	—	16·8	18·7	20·6	21·1	22·4	27·0	26·4	31·2
Birket*	—	7·3	8·1	9·4	10·9	12·5	13·0	13·6	15·2	—	—
Llyn Tegid*	—	7·2	10·7	13·5	15·8	17·7	19·5	21·3	—	—	—
Madingley†	—	8·9	10·1	14·2	18·0	—	—	—	—	—	—
Barrington†	3·6	6·8	10·6	13·0	16·0	18·0	21·5	24·1	23·1	27·4	—
North Germany† Stettin Harbour	4·3	8·9	12·5	14·7	19·3	23·1	25·9	30·0	31·0	33·8	—
Sweden† Kloten	3·0	5·3	8·1	10·9	13·2	14·7	17·0	19·0	20·1	21·8	—
Hjarlomeus†	3·0	5·8	7·8	10·6	13·0	15·0	16·7	18·3	20·3	20·8	—
Sogaard-S‡	2·0	3·5	5·0	8·7	10·0	—	—	—	—	—	—
Hampen-S‡	3·5	10·0	15·7	23·7	29·0	30·7	—	—	—	—	—
Goplo Lake‡	—	5·0	9·0	12·5	15·0	17·0	19·6	22·0	24·0	27·0	28·0

*From Jones 1953. †From Hartley, 1947. ‡From Strangenberg, 1956—(total lengths given).

TABLE 2.—The Sex and the Condition of the Gonads in the different Age Groups.

AGE GROUPS	MALES			Total No. of Males Examined	FEMALES			Total No. of Females Examined
	Full	Spent	Immature		Full	Spent	Immature	
3 ..	18	5	4	27	5	2	3	10
4 ...	6	4	—	10	3	2	2	7
5 ...	15	1	—	16	14	3	—	17
6 ...	15	1	—	16	12	4	—	16
7 ...	—	1	—	1	1	—	—	1
8 ...	—	—	—	—	4	—	—	4
9 ...	1	—	—	1	6	2	—	8
10 ...	1	—	—	1	—	—	—	1
				72				64

TABLE 3.—The Food of Roach in the Funshion.

Centimetre Length Groups		Type of Food. Trichoptera larvae	Chironomid larvae	*Simulium* sp. larvae	Ephemeridae nymphs	*Perla* sp. nymphs	Chironomid pupae	*Simulium* sp. pupae	Hydracarina	*Gammarus duebeni*	*Anodus fluviatilis*	Mollusca	Diatoms	Algae	Musci	Angiosperms	Number examined
15–20 ...	Dominant	2	11	—	1	—	—	—	—	—	—	—	—	1	—	1	16
	Present ...	8	14	1	5	—	1	2	3	—	1	—	2	5	—	12	
20–25 ...	Dominant	10	17	1	—	—	—	—	—	—	—	2	—	1	—	2	33
	Present ...	15	25	1	6	—	5	1	3	—	1	4	6	12	—	21	
25–30 ...	Dominant	5	2	—	—	—	1	—	—	—	—	—	—	5	—	—	13
	Present ...	5	6	1	2	1	3	—	—	1	—	1	3	9	—	9	
30–35 ...	Dominant	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	2
	Present ...	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	

TABLE 4.—Average lengths and weights of dace for each age group in the different months.

Age Group	Average length in cm. April	May	June	Average weight in gm. April	May	June
0 ...	—	8·7	—	—	10	—
2 ...	19·6	18·2	18·7	57	65	70
3 ...	22·1	19·8	22·5	86	82	116
4 ...	23·5	22·4	23·9	109	118	138
5 ...	24·6	23·4	25·6	127	130	165
6 ...	—	24·4	26·6	—	144	189
7 ...	—	25·7	27·6	—	143	216
8 ...	—	27·0	27·4	—	150	205
9 ...	—	29·2	29·8	—	195	253

TABLE 5.—The Food of Dace in the Funshion River.

Centimetre Length Groups	Number examined		Type of Food																
			Hirudinea	Trichoptera larvae	Chironomid larvae	*Simulium* sp. larvae	Ephemeridae nymphs	*Perla* sp. nymphs	Chironomid pupae	*Simulium* sp. pupae	Adult flies	Hydracarina	*Gammarus duebeni*	*Anglus fluviatilis*	*Pisidium* sp.	Diatoms	Algae	Angiosperms
5–10 ...	1	Dominant	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
		Present ...	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
10–15 ...	1	Dominant	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
		Present ...	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—
15–20 ...	20	Dominant	—	—	18	1	—	—	—	—	—	—	—	—	—	1	—	—
		Present ...	—	6	18	8	—	—	9	2	1	—	2	2	—	1	3	—
20–25 ...	81	Dominant	1	5	43	7	4	—	3	1	2	—	—	—	—	—	15	—
		Present ...	3	34	65	15	34	1	27	9	2	—	2	4	2	19	28	3
25–30 ...	6	Dominant	—	2	3	1	—	—	—	—	—	—	—	—	—	—	—	—
		Present ...	—	5	6	1	2	—	2	1	—	—	1	1	—	—	1	—

APPENDIX No. 26.

SALMON OF THE RIVER MOY

By

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The River Moy is 62½ miles long and has a catchment area of 805½ square miles (Hely-Hutchinson, 1901). Loughs Conn and Cullin are included in this area. The Moy Fishery Company, as owners of the several fishery in the tidal portion of the river, operated 9 draft nets in 1954, 8 in 1955 and 5 in 1956 together with a salmon weir at the head of the tideway. Weir fishing commences on February 1st and draft net fishing on March 15th.

There were marked fluctuations in the proportion of fish sampled over different parts of the season and consequently the percentages given in the various Tables (*see* appendix for all Tables) have been arrived at on the basis of the distribution of the catches throughout the three seasons in question.

Material and Methods.—The material used in these investigations consisted of 746 sets of scales, with relevant data relating to length, weight, etc., collected from April to July, 1954, and 1,136 and 1,296 similar sets taken from February to July in 1955 and 1956, respectively.

Smolt Ages.—The distribution of the smolt classes in the different years are given in Table 1. The two-year-old smolts were the most important. The proportion of one-year-old smolts in 1954 and 1955 (15·8% and 13·9%, respectively) was in the same order as that obtained by Went (1947) in a previous investigation of the River Moy. The 1956 figures (25·2%) were higher than those obtained in any previous investigation into Irish salmon (Went, 1956, pp. 2 and 3). In the grilse there was an increase in the one-year-old smolts as the season progressed in 1954 and 1955 but in 1956 the results were irregular. The years 1954 and 1955 also showed an increase in the one-year-old smolts as the age groups were ascended, the reverse being the case in 1956.

Smolt Types.—Went (1938) described two smolt types in Irish waters namely (i) Type A smolts (those which show little or no growth in fresh water in the spring of year before migration to the sea) and (ii) Type B smolts (those which show evidence of growth, more than two annuli on their scales before migration). The distribution of the two different smolt types for the one, two and three-year-old smolts are given in Table 2. Over 62·3% of the fish examined belonged to the two-year-old Type B class in the three years in question.

Age Groups.—The fish examined can be divided into (*a*) maiden or unspawned and (*b*) those which have spawned previously.

The unspawned fish of the River Moy belonged to one of three main age groups (i) grilse (1+ winters), (ii) small spring fish (2 winters) and (iii) small summer fish (2+ winters). Six large spring fish (3 winters) were recorded for 1955 and 3 for 1956, but none for 1954. Previously spawned fish (with S.M's) can be classified on (i) their age at first spawning and (ii) the " absence " habit, i.e., the period spent feeding in the sea before their return to spawn for a second or subsequent occasion.

The bulk of the fish in the three years under review were grilse (1+ winters). The small summer fish (2+ winters) were next in importance whilst the small spring fish (2 winters) accounted for 5·6% or less of the stocks. In 1954, previous spawners accounted for 2·4% of the total, in 1955 4·4% and in 1956 5·9%. All the previous spawners captured in 1954 had a single spawning mark on the scales. In 1955 and 1956, however, 5 fish (8·0%) and three fish (5·1%), respectively, had two spawning marks on their scales. In 1955 one fish (1·6%) had three spawning marks on its scales (Plate 1). Fish with three spawning marks on their scales are exceedingly rare in Irish waters (Went, 1956, p. 21). The fish in question weighed 25¾ lb. and was 43 inches in length. It had spawned first as a grilse and it was returning to spawn for a fourth time when it was captured in April, 1955.

In February, March and April in 1955 and 1956 and in April. 1954 small spring fish were dominant. The majority of the small summer fish were taken in May each year. In June and July 80·8% and upwards of the fish taken were grilse. The percentage of previous spawners taken in February, March and April, 1955, was very high.

The bulk of the spring fish were taken in April in 1954 and 1955 and in February and March in 1956. Small summer fish were caught in greatest numbers in May each year. The greatest number of grilse were taken in July, 1954 and 1956 and in June, 1955. In 1954 over 40% and in 1955 over 50% of the total catch was taken in June, but in 1956, 53·6% of the total was taken in July.

The majority of the fish entering the river up to the end of April were spring fish. In May the proportion of spring to summer fish was reversed. A few scattered spring fish were recorded for June and July (Table 3).

In Table 4 the previous spawners for the three years combined have been classified according to (i) their age at first spawning and (ii) the absence habit. The majority of the grilse returned to spawn for a second time after a short absence (less than a full year); a small proportion returned after a very long " absence " (more than a full year). The previous spawners derived from small spring fish exhibited the long " absence " habit (one full year at sea). A few small summer fish running in 1956 were absent more than one full year.

Commercially the grilse were the most important being

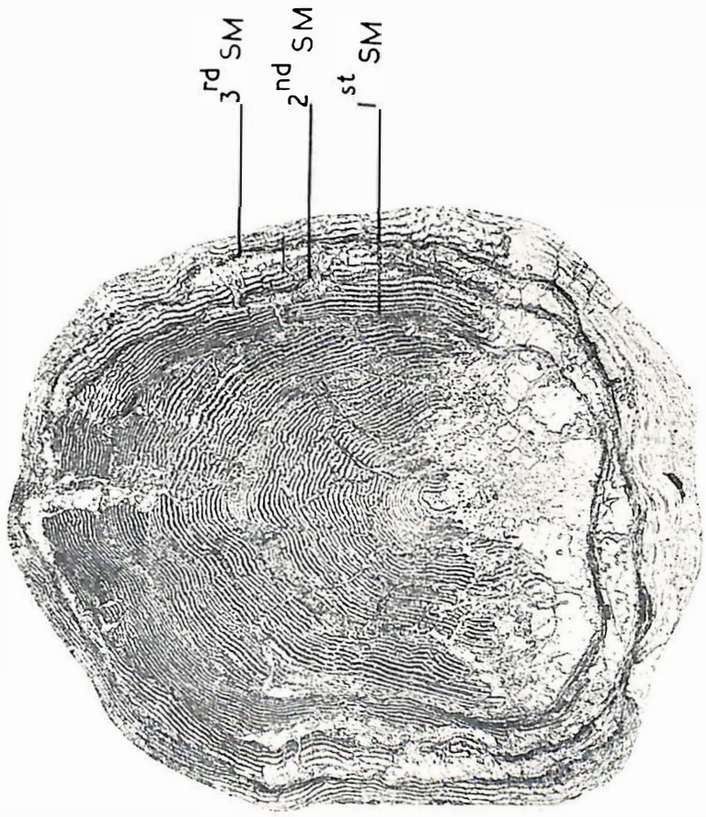

Plate 1. Photomicrograph of a scale of a previous spawner with three spawning marks. (Weight, 25¾lb. Length, 43", Fish taken on 28 4 55). Magnification ca.10 diameters.

responsible for 46·9% and 44·1% in 1955 and 1956 respectively. The small spring fish were next in importance in 1955 and 1956 (Table 5). Owing to the fact that there were no scale samples obtained for February and March, 1954, no weight calculations were made for that year.

Proportion of fish in the different brood years.—The greatest proportion of the Moy fish were grilse belonging to the two-year-old smolt class. As a result the bulk of the fish taken in each of the three years in question belonged to the brood of a single year (Table 6). The next most important groups were the small spring and small summer fish which migrated as two-year-old smolts.

Size distribution.—In the three years under review more than half the stocks had lengths ranging between 21·95 and 25·95 inches and more than 86% were under 29·95 inches (Table 7).

Proportion of the Sexes.—The sex of each fish as determined by visual observation was recorded. This method is not, however, fully reliable but from the data obtained it would appear that the sexes were fairly evenly distributed.

Average Sizes.—Details of maximum mean and minimum lengths and weights are as follows :—

(1) Grilse (1+ winters).

	1954 Number examined = 453			1955 Number examined = 774			1956 Number examined = 783		
	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture
Minimum	2·5	18·2	21/6/54	2·0	16·5	6/6/56	1·5	16·2	13/6/56
Mean ...	5·9	24·0	—	4·9	22·9	—	5·3	23·2	—
Maximum	11·0	29·3	26/5/54	9·0	28·0	6/7/55	10·0	28·9	19/7/56

The grilse showed an increase in weight as the season progressed when all smolt classes were combined.

(2) Small spring fish (2 winters).

	1954 Number examined = 99			1955 Number examined = 167			1956 Number examined = 291		
	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture
Minimum	5·7	24·5	26/5/54	4·1	22·0	30/4/55	5·2	23·2	30/3/56
Mean ...	10·0	28·7	—	10·3	30·1	—	9·7	28·9	—
Maximum	15·5	31·1	25/4/54	18·4	34·0	31/3/55	15·7	33·0	28/2/56

There was a tendency in the small spring fish to decrease in weight as the season progressed.

(3) Small summer fish (2+ winters).

	1954 Number examined = 165			1955 Number examined = 110			1956 Number examined = 150		
	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture
Minimum	6·0	25·0	26/5/54	6·3	25·2	11/7/55	5·0	22·6	1/5/56
Mean ...	11·6	29·8	—	11·9	30·3	—	10·9	29·0	—
Maximum	26·5	39·0	30/6/56	17·0	34·0	6/6/55	18·0	35·5	30/3/56

The small summer fish showed an increase in weight up to July.

(4) Large spring fish (3 winters).

	1955 Number examined = 6			1956 Number examined = 3		
	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture
Minimum ...	15·0	31·8	19/4/55	15·2	33·3	28/2/56
Mean	16·4	34·8	—	18·6	35·2	—
Maximum ...	20·0	37·0	21/4/55	20·0	36·0	12/4/56

(5) Previous spawners (with SM's).

	1954 Number examined = 18			1955 Number examined = 58			1956 Number examined = 63		
	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture	lbs.	ins.	Date of capture
Minimum	5·7	24·5	24/6/54	5·0	23·5	29/6/55	5·7	24·5	13/6/56
Mean ...	8·9	28·0	—	12·6	31·7	—	12·7	31·1	—
Maximum	16·7	36·0	4/6/54	25·7	43·0	28/4/55	22·0	38·0	28/5/53

Condition.—The weight/length relationships or condition co-efficients, according to Menzies scale (Menzies 1921), are given in Table 8. The earlier run fish in the case of the grilse and the previous spawners had a lower average condition co-efficient than the later run fish. The results in the small spring and small summer fish showed great fluctuations. In 1954 and 1956 the condition of the spring fish was higher than that of the summer fish but in 1955 the reverse was the case.

Erosion of the Scale.—None of the fish taken before July each year had eroded scales, only 1·1% of the fish taken in July 1954, showed erosion on their scales, whereas in 1955 and 1956 the figures were 5·2% and 9·3%, respectively.

Calculated Lengths.—A number of fish from each age group were selected at random for growth determinations. The growth was calculated on the assumption that the growth of the scales is strictly proportional to the growth of the body. In Table 9 the growth of the one, two and three-year-old smolt classes are given. The growth rate of the one-year-old smolts was higher than either the two or the three-year-olds in their first year,

but the two and three-year-olds were longer at migration than the one-year-olds. This is true for most rivers in Ireland (Went, 1956, p. 7).

A comparison was made between the growth of Type A and Type B smolts in the one and two-year-old smolt classes (Table 10). The Type A smolts were longer than the Type B smolts in each smolt class.

The calculated average lengths at the end of each winter of river and sea life for the different age groups are given in Table 11. The average calculated lengths of the small spring fish at the end of their first sea year exceeded both that of the grilse and small summer fish. At the end of the second sea year the small spring fish were slightly longer than the small summer fish. The smolts of the small spring fish were longer at migration than those of either the grilse or small summer fish (Table 12).

RESUMÉ.

1. The two-year-old smolts formed over 70% of the total in each of the years under review (Table 1). There was an increase in the one-year-old smolts as the age groups were ascended in 1954 and 1955 but there was a decrease in 1956.

2. Over 62·0% of the fish were composed of two-year-old Type B smolts (Table 2).

3. The bulk of the fish taken were grilse, small summer fish being next in importance. The percentage of previous spawners was low in 1954. Over 80% of the fish taken in June and July were grilse. The bulk of the small summer fish were taken in May and the small spring fish in April. The greatest number of fish were taken in June in 1954 and 1955 and in July in 1956. Spring fish were dominant up to April each year and thereafter summer fish predominated (Table 3).

4. The majority of the fish exhibited the short "absence" habit (Table 4).

5. The grilse were the most important age group commercially. In 1955 and 1956 the small spring fish were next in importance to the grilse (Table 5).

6. In each year 62·3% and upwards of the stocks belonged to a single brood year (Table 6).

7. More than half the stocks had lengths between 20·95 and 27·95 inches (Table 7).

8. The proportion of the two sexes appear to be approximately equal.

9. Average weights of the various age groups for each of the years under review are given.

10. There was an increase in the condition co-efficient as the season progressed except in the case of the small spring fish.

11. The fastest growing parr migrated first (Table 8). The Type A smolts were longer than the Type B smolts of the same year class at the end of each winter of freshwater life (Table 9).

12. At the end of their first winter at sea the spring fish were longer than either the grilse or small summer fish and by the end of their second year they were longer than the small summer fish. The smolts of the spring fish were longer at migration than those of either the grilse or the small summer fish (Tables 10 and 11).

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References.

Hely-Hutchinson, G. W. (1901), *Tables of Irish Rivers*, Dublin.

Menzies, W. J. M. (1921), *Salmon of the Dee* (Aberdeen), 1921.

Went, Arthur E. J. (1938), "Salmon of the River Shannon". *Proc. Roy. Irish Acad.*, 44B, 11; (1947), Irish Salmon, 1945, *Sci. Proc. Roy. Dublin Soc.*, (N.S.) 24, No. 20.; (1955), *Irish Salmon and Salmon Fisheries*, London.

Table 1.—Percentage of each smolt age in each year.

Year	Smolt Class 1	2	3	Average age of smolts
1954 ...	17·3	82·0	0·7	1·81
1955 ...	13·9	83·5	2·6	1·88
1956 ...	25·2	72·6	1·2	1·74

Table 2.—Estimated proportion (%) of the different smolt types in each smolt class (maiden fish only).

Year	1954		1955		1956	
Smolt Age	Type A	Type B	Type A	Type B	Type A	Type B
One year	—	17·3	—	13·9	—	23·7
Two years	19·7	62·3	17·8	65·7	12·0	62·3
Three years ...	0·7	—	2·6	—	2·0	—
Total ...	20·4	79·6	20·4	79·6	14·0	86·0

Table 3.—Estimated monthly catch in each age group as percentage of the yearly total.

1954.

Age Group (in winters).

Month	1+	2	2+	3	With SM's	Total
April ...	—	3·6	2·3	—	0·2	6·1
May ...	0·9	2·7	5·6	—	0·1	9·3
June ...	35·0	1·3	6·4	—	1·0	43·7
July ...	38·3	0·3	1·2	—	1·1	40·9
Total ...	74·2	7·9	15·5	—	2·4	100·0

1955.

Feb./March	—	1·0	—	0·1	0·2	1·3
April ...	+	1·4	0·8	0·1	0·4	2·7
May ...	3·2	1·4	4·3	—	0·5	9·4
June ...	47·9	0·3	3·2	—	0·9	52·3
July ...	31·1	0·2	0·6	—	2·4	34·3
Total ...	82·2	4·3	8·9	0·2	4·4	100·0

1956.

Feb./March	—	1·0	0·1	0·1	0·2	1·3
April ...	—	2·4	0·1	—	0·1	2·6
May ...	1·7	1·2	2·3	—	0·5	5·7
June ...	33·1	0·2	3·0	—	0·5	36·8
July ...	46·9	0·8	1·3	—	4·6	53·6
Total ...	81·7	5·6	6·7	0·1	5·9	100·0

+ less than 0·05%.

TABLE 4.—Absence habit of previous spawners expressed as a percentage.

Absence Habit	1954	1955	1956
Short	72·2	67·2	84·8
Long	16·7	20·2	11·4
Very long	11·1	12·6	3·8
TOTAL ...	100	100	100

TABLE 5.—Percentage composition by weight.

YEAR	AGE GROUP IN WINTERS					
	1+	2	2+	3	With SM's	Total
1955 ...	46·9	24·3	19·0	0·5	9·3	100·0
1956 ...	44·1	30·3	16·3	1·6	7·7	100·0

TABLE 6.—Proportion (%) of the different brood years in the catch of the different years.

Brood Year	RETURNED IN		
	1954	1955	1956
1947	—	0·1	—
1948	0·2	0·3	—
1949	0·1	1·7	0·2
1950	21·1	0·8	2·2
1951	66·7	14·8	1·2
1952	11·9	70·4	12·9
1953	—	11·9	62·3
1954	—	—	21·2
TOTAL ...	100·0	100·0	100·0

TABLE 7.—Estimated size distribution as a percentage of the total catch in 1954, 1955 and 1956.

Class Interval*	1954	1955	1956
16	—	0·5	0·8
18	1·3	2·2	3·7
20	7·3	17·1	9·9
22	28·3	38·2	38·5
24	29·4	21·4	26·1
26	11·1	4·4	6·5
28	9·3	5·5	5·7
30	9·4	5·7	4·4
32	2·7	2·4	2·2
34	6·9	0·9	1·4
36	0·3	0·3	0·5
38	—	0·9	0·2
40	—	—	0·1
TOTAL ...	100·0	100·0	100·0

*Class interval 16, etc., includes all fish with lengths between 15·95 and 16·95 inches, etc.

TABLE 8.—Average condition co-efficient (K) in the more important age groups.

AGE GROUP	YEAR		
	1954	1955	1956
1+	1·16	1·04	1·16
2	1·16	1·13	1·10
2+	1·14	1·17	1·12
With SM's ...	1·12	1·13	1·12
Spring fish ...	1·13	1·13	1·11
Summer fish ...	1·15	1·11	1·14

TABLE 9.—Calculated growth in freshwater in the different smolt classes.

Smolt Age	1st Year	2nd Year	3rd Year	Average smolt length in inches
1954				
1 ...	2·2	—	—	3·9
2 ...	1·8	3·8	—	5·4
3 ...	1·6	3·3	5·6	5·1
Average	1·9	3·8	5·6	4·9
1955				
1 ...	2·8	—	—	4·6
2 ...	1·9	4·3	—	5·1
3 ...	1·5	3·2	5·3	5·3
Average	2·0	4·2	5·3	5·0

TABLE 10.—Calculated lengths of the different smolt types in the one and two year smolt classes.

1954

	Growth Type					
	A			B		
	1 year	2 years	Length of Smolt	1 year	2 years	Length of Smolt
1 year ...	—	—	—	2·2	—	3·9
2 year ...	2·0	4·5	4·5	1·7	3·6	4·8
1955						
1 year ...	—	—	—	2·8	—	4·6
2 year ...	2·2	4·9	4·9	1·8	4·0	5·1

TABLE 11.—Calculated average length in inches at the end of each winter of river and sea life.

Age Group	1954. River Life			1954. Sea Life			1955 River Life			1955 Sea Life		
	1	2	3	1	2	3	1	2	3	1	2	3
1. 1+ ...	2·1	3·7	—	18·2	—	—	2·8	4·5	—	17·5	—	—
2. 1+ ...	1·6	3·4	4·6	19·3	—	—	1·9	4·2	—	18·8	—	—
3. 1+ ...	1·5	2·9	4·4	19·1	—	—	1·5	3·1	5·2	17·4	—	—
1. 2	2·3	4·0	—	19·2	29·2	—	2·7	5·0	—	19·3	28·1	—
2. 2	1·9	4·3	5·4	21·2	30·4	—	1·8	4·1	—	20·2	28·9	—
3. 2	1·8	3·8	5·8	20·1	30·0	—	1·5	3·5	6·3	21·2	29·9	—
1. 2+ ...	2·4	—	—	19·4	27·9	—	2·7	—	—	19·2	29·7	—
2. 2+ ...	1·8	3·6	—	18·8	27·9	—	2·0	4·5	—	18·9	28·4	—
3. 2+ ...	—	—	—	—	—	—	1·2	3·0	5·3	19·1	29·0	—
2. 3	1·8	3·8	—	17·5	25·5	31·2	2·4	4·6	—	17·9	28·6	34·8
2. 3+ ...	1·8	3·2	—	19·8	27·0	32·9	—	—	—	—	—	—

TABLE 12.—Calculated mean length in inches at the end of each winter in the sea in the various age groups.

1954

Age Group	Length of Smolts	Sea Life 1st Year	Sea Life 2nd Year	Sea Life 3rd Year
1+ ...	4·3	18·8	—	—
2 ...	5·1	20·2	29·3	—
2+ ...	4·1	18·7	27·9	—
1955				
1+ ...	4·9	18·4	—	—
2 ...	5·3	18·8	28·7	—
2+ ...	5·1	19·0	28·6	—
3 ...	5·7	17·0	28·6	34·8

APPENDIX No. 27.

FERTILISATION OF SOME ACID OR BOG LAKES IN IRELAND

By

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In 1950 a scheme for the improvement of brown trout by fertilisation of lake waters was initiated. For this purpose four lakes, Kinlooey Lough, Westport, Co. Mayo; Lough Aunemlagh near Clifden, Co. Galway; Lough Ananima, near Glenties, Co. Donegal; and Barfinnihy Lough, which is situated in the McGillycuddy Reeks, 1,250 ft. above sea level between Killarney and Kenmare, Co. Kerry, were selected. The waters of all four lakes were found to be acid (pH ranging from 6·0 to 6·8). The addition of fertilisers to the two first-named lakes began in April, 1951, and was continued until the autumn of 1953. The fertilisation of the other two lakes commenced in 1952 and was continued until the autumn of 1954.

Each lake contained trout and eels and in addition gudgeon and sticklebacks were present in Kinlooey Lough. Trout in all the four lakes were plentiful but small in size. The stocks were maintained by the natural spawning facilities in the efferent streams. Barfinnihy Lough, however, has no efferent stream except tiny rivulets coming from springs in the mountain. It is believed that the fish from the lake spawned on the sandy northern shore.

Lough Aunemlagh, Kinlooey Lough and Lough Ananima can be classified as dystrophic lakes. This type of lake has a peaty bottom, it is generally surrounded by unproductive marsh land and the water is stained brown. Hasler *et al* (1951) found that owing to the colour of the water in the brown water bog lakes of Wisconsin that light penetration is poor and as a result the volume of the food producing (trophogenic) zone is small, and Neess (1946) noted that owing to the acid nature of the water the rate of decomposition is reduced and nitrogen fixation is inhibited. Calcium deficiency is characteristic of this type of lake. The macro flora of these three dystrophic lakes consisted of *Juncus*. sp. *Carex* sp., isolated patches of *Nymphea* sp. and *Potamageton* sp. The micro fauna consisted of caddis larvae, *Gammarus duebenii*, and a few mollusca. Some Hemiptera were also noted on the surface of the water.

Barfinnihy Lough can be described as a moderately deep oligotrophic lake. It is almost circular in shape and is surrounded by large stones and boulders. There was no vegetation of any kind to be seen in the lake before fertilisation. The macro fauna was very scarce, isolated samples of caddis larvae and some

aquatic beetles were noted. This lake is fed by springs which come from the Boughill mountain which overlooks the northern shore of the lake. Springs also occur in the lake bottom. The water in this lake appeared to be maintained at a constant level even during the very dry summer of 1955. Its waters are crystal clear, but owing to its depth and the fact that it is situated in a basin between high mountains, light penetration is poor. The area, average and maximum depths of each lake are given in Table 1.

EXPERIMENTAL METHODS.

Before fertilisation began a total of 100 trout were taken by rod and line from each of the lakes. Details of length, weight and date of capture were recorded. Some scales were taken from the shoulder and stomach contents were taken in some cases for analysis. Age determinations were made from scale readings, and the length, weight and condition of the different age groups were calculated. A further sample was taken following the three years of fertilisation, a comparison being made between the data of the pre-fertilisation trout and those taken after fertilisation was completed.

A sample of water for analysis was taken before the application of the artificial fertilisers also during fertilisation, and a final sample was taken the year following the last application of fertilisers. Fertilisers were applied in April of each year. Ground limestone was applied at the rate of 8 cwt. per acre. A fortnight after the application of ground limestone, Superphosphate 39% (Ca^3 $(PO^4)^2$) was applied at the rate of 1½ cwt. per acre and the commercial Potassium chloride (Muriate of potash) (60% KCL) at the rate of ½ cwt. per acre. The amount of ground limestone used is the quantity recommended for a lake with a pH. between 6·0 and 6·8 by the Freshwater Biological Association of the British Empire in their Scientific Publication No. 6. They also recommend 1½ cwt. of superphosphate and ½ cwt. of potassium chloride. These quantities compare favourably with the amount recommended by other workers (*see* review by Mortimer and Hickling, 1954). In the case of Lough Ananima where ground limestone alone was used, the quantity applied was 1 ton per acre.

Demoll (1925) recommends 2,000 to 5,000 Kg/ha (20 to 50 cwt. per acre) of ground limestone, whereas Wunder (1949) recommends 10 to 20 cwt. per acre of quick lime. In an interview with Mortimer, Wunder stated that lime only in the form of quick lime was effective. Other workers, however, recommend ground limestone. Ohle (1938a) and Reinecker (1936) state that there is a danger of too high a pH value with quick lime, also owing to the toxic nature of quick lime it may prove harmful to the fish population. Sixty tons of ground limestone applied to Lough Ananima were given in three applications during the year—spring, summer and autumn.

The artificial fertilisers were applied in the other three lakes a fortnight after the addition of ground limestone, firstly to prevent the formation of insoluble calcium phosphate and secondly because it was necessary to make the lakes alkaline. Wunder (1949) stresses that superphosphate is of little value without previous liming. Smith (1948) states that the productive capacity of Crecy Lake was improved without the addition of lime before fertilisation, also that there was an increase in the pH value from 6·7 to 8·2 in the lake water. In this matter Smith differs from all other workers whose publications were available to the author.

The ground limestone and artificial fertilisers were applied by broadcasting from sacks placed at the back of a row boat. The ground limestone was spread evenly over the surface of the lake except at the big outlet which was present in Kinlooey Lough. The outlets from the other lakes were dammed during fertilisation, but it was not possible to dam this outlet. The artificial fertilisers were applied sparingly in the deeper parts of the lake and care was taken to avoid the growth of reeds and rushes when applying the fertilisers. Wunder (1949) advises the elimination of all "hard" plants before fertilisation, not only because they are useless as a substratum for fish food, but also because of their high silica content they will not readily decay. They also exclude light and warmth, thus diminishing the growth of plankton.

The fertilisers were applied in April and again in August. The American workers recommend the addition of fertilisers throughout the growing season, since the fertilisers are utilised by the plankton 24 to 72 hours after application. Smith (1947), Ball (1951) recommends an application every three weeks, but the German workers Demoll (1925) and Wiesner (1936) found that small doses of fertilisers were not effective and proved very expensive in the lakes studied by them.

The fertilisers selected for use.—The waters of the four lakes chosen for fertilisation were poor in the most important elements for fish culture. Phosphorus is considered by fish culturists on the Continent and in America to be the most essential element. Demoll (1925) states that it is unlikely that a case exists in which phosphorus would not be beneficial but Wunder (1949) found that it had no effect on acid waters without previously liming them, however Smith (1948) as we have already seen got good results in Crecy Lake without the addition of lime.

Potassium salts were found to be effective in peaty soil but in lakes of medium or high productivity it is doubtful whether their addition will produce any large increase in fish crop. According to Neess (1949) potassium salts are present in small amounts in natural waters, and for that reason it was considered by several workers as a fertiliser.

Calcium is considered to be one of the most important elements for high productivity. Southern (1935) has shown that Irish

lakes with a high calcium concentration produce better trout than lakes which lack calcium and Ball (1948) states that there seems to be a positive correlation between alkalinity and fish production.

Chemical Effects of Fertilisation.

The chemical analyses of the lake waters before and after fertilisation are given in Table 2. The phosphorus content is estimated in parts per million of phosphorus pertoxide; the calcium in parts per million of calcium oxide and the potassium in parts per million of potassium oxide. Chemical analyses of the four lakes showed them to be similar in all respects before fertilisation. They had a pH below 7; the phosphate content was nil. The calcium content of the waters of Kinlooey Lough was relatively high, but in the other three lakes it was low. The fairly high concentration of calcium in Kinlooey Lough can be accounted for by the fact that there is a vein of limestone near the north western shore, the rest of the shore line being peaty.

During fertilisation the pH of Kinlooey Lough and Lough Aunemlagh rose to 8·2 and 7·4 respectively, but the final water analyses taken one year after fertilisation gave a pH of 7·3 and 7·0 respectively. The pH values of Lough Ananima and Barfinnihy Lough were 6·0 and 6·4 before fertilisation. They rose to 7·1 and 7·0 respectively during fertilisation, but again fell to 6·4 and 6·8 a year after fertilisation. Neess (1949) in his survey of literature dealing with pond fertilisation states that a weakly alkaline reaction (pH 7 to 8) has been found most productive in fish pond waters.

All four lakes showed an increase in calcium content after fertilisation. Kinlooey Lough and Lough Aunemlagh had calcium content of 53 and 28 p.p.m. one month after the final fertilisation, but one year after fertilisation it fell to 44 and 17 p.p.m. respectively. The calcium content of Lough Anamina and Barfinnihy Lough did not rise higher than 18·7 and 21 p.p.m. respectively. All these post-fertilisation figures for calcium content are considered to be much below that required for good productivity.

The phosphate content of all four lakes before fertilisation was nil. Analyses taken during fertilisation showed an appreciable rise in phosphorus content, but post-fertilisation analyses showed a decline again, but not back to its former level. Smith (1948) also observed that immediately after fertilisation there was an appreciable rise in phosphorus content, but values even approximating the first sampling after fertilisation were not realised in subsequent sampling. Barrett (1952) states that nearly 100 per cent. of added phosphorus disappears from the epelimnial

waters within a year following fertilisation and Olive (MSS unpublished) found that the sedimentary peat in East Rainbow Lake yielded 4·8 p.p.m. of phosphorus when the open waters had a concentration of only 1·51 p.p.m. Neess (1949) quotes Breest as stating that phosphorus applied in one year is still able to elicit a response in years following. The amount of phosphorus required for maximum productivity is not known. Irwin in a discussion with Hasler and Einsels (1948) states that it is not a case of having a great amount of phosphorus, it is more a case of having some, but he quotes Smith and Swingle as checking it down to 2 p.p.m.

There was only a "trace" of potassium in the lake waters under review prior to fertilisation. The optimum concentration of this element for fish production is not known, but it has been proved that in waters where potassium is present the further addition does not increase the yield of fish. Neess (1949) cites a case where Demoll added potassium to a pond which previously contained 1·35 p.p.m. of K_2O. The potassium concentration was increased to 11 p.p.m., but this increase did not affect the yield of fish. The increase in the potassium content of all four lakes can be noted in Table 2. The increase in potassium content of Lough Ananima cannot be accounted for since no potassium was added to this lake.

General Biological Effects of Fertilisation.

The addition of ground limestone to all of these lakes had the effect of making the water clearer, thus increasing the light penetration which resulted in an increase in the volume of the trophogenic zone. Although no quantitative analyses of plankton were made, observations indicated an increase in plankton growth after fertilisation. Smith and Swingle (1947) noted an increase in plankton 24 to 72 hours after fertilisation. During the first year of fertilisation it was observed that the lakes became cloudy with plankton and the cloudiness lasted until late summer. This condition continued during the three seasons of fertilisation. However, in 1955 (a year after the last application of fertiliser) the phytoplankton of Barfinnihy Lough was replaced by filamentous algae (mostly Spirogyra sp.), these filamentous algae caused an unsightly and malodorous condition. Ball and Tanner (1951) had considerable trouble from filamentous algae when fertilising warm water lakes in Michigan and they report that several workers had the same difficulty. The continuous high temperatures which prevailed during the summer of 1955 may have been responsible for the growth of algae in Barfinnihy Lough. The same observations were made by the author in many rivers and lakes through Ireland. The other fertilised lakes were not affected by this abnormal growth of filamentous algae, possibly because by 1955 the effect of the addition of fertilisers in the other three lakes had disappeared.

The Effect of Fertilisation on the Fish Population.

From the economic point of view the best index of the value of artificial fertilisers is the increase in the weight of the fish crop. For that reason more attention has been paid to this than to plankton counts and bottom fauna production in the present experiments.

(a) *Age and growth analyses.*—The calculated lengths of the trout at the end of each year of life before and after fertilisation are given in Table 3. The growth rate was calculated on the assumption that the growth of the scales was strictly proportional to the growth of the body. These figures show that the increase in growth rate, if any, is very slight, but it must be considered that the total for all age groups is included in the results and this total includes fish which did not benefit by fertilisation or else had only the benefit of one year's increased food supply. The growth rate of the one and two year old fish prior to and after fertilisation is given in Table 4, and is represented graphically in Fig. 1. It can be seen that there is a significant increase in length when only the younger fish are taken into consideration. Lough Ananima has been excluded from this table since it did not show any increase even in the younger fish. Ball and Tanner (1951) also found that the change in growth rate of the pumpkin seed fish was of much greater significance when the fish that had completed two seasons' growth during fertilisation was compared with fish that had completed one year's growth prior to fertilisation and the second during fertilisation. When the calculated lengths of the 3 year old fish prior to fertilisation was compared with post-fertilisation results the figures were not found to be significantly smaller. These results suggest that the addition of fertilisers had little or no effect on the growth rate of trout during the first year of application, but in the second and third year the growth rate showed a marked increase. A possible explanation of this is that owing to the acidity of the lake waters the fertiliser had no effect on the food supply after the first year's applications and it was only when the lake waters were made alkaline that the effect of the fertilisers was beneficial. Smith (1954) got an increase in mean fork length from 3·2 to 8·5 inches from September, 1946 to May, 1947 in brook trout fingerlings which were planted in Crecy Lake, New Brunswick, after fertilisation. Fingerlings from the same hatchery were planted in Gibson Lake which was not fertilised. The increase in mean fork length from August, 1946, to May, 1947, was only from 2·9 to 4·4 inches. Juday *et al* (1938) got an increase in length of 16% in the perch of Weber Lake after fertilisation and there was an increase in length from 3·15 to 4·44 inches in the one year old small-mounted Black bass.

In Barfinnihy Lough the effect of the fertilisers can be seen in the growth rings of the scales even during the first season of fertilisation. During the second year of fertilisation the fish

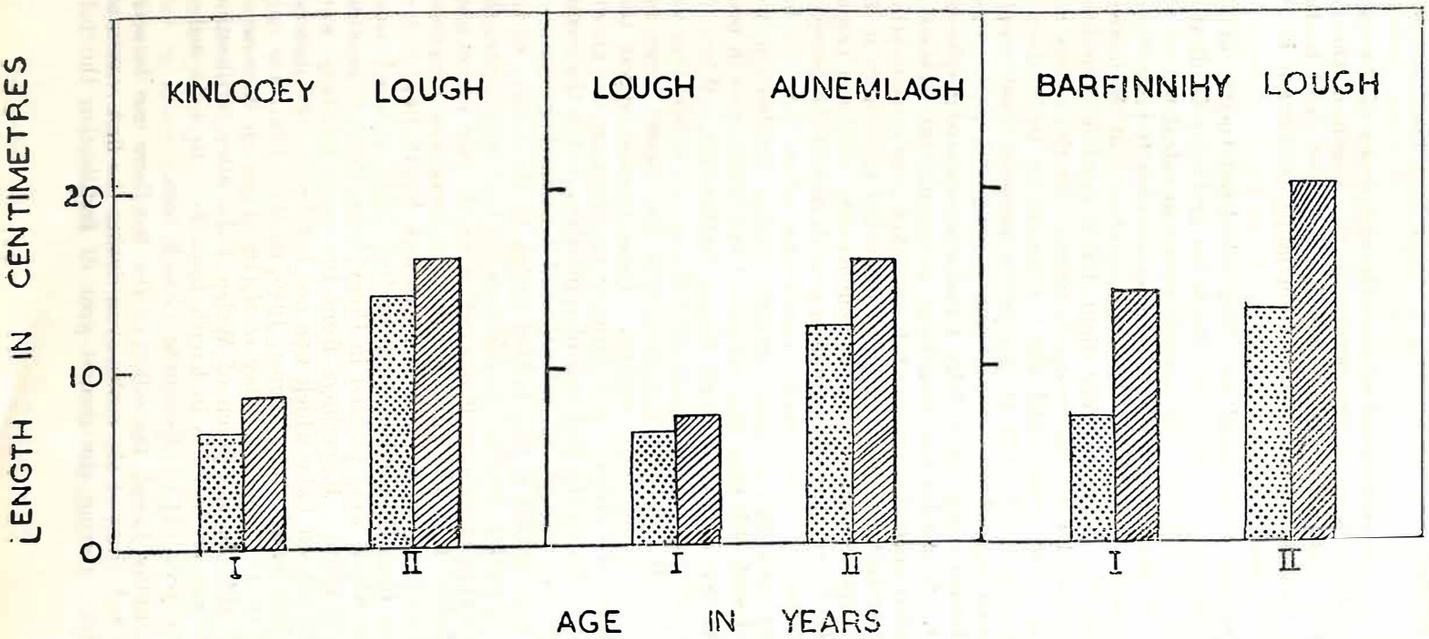

FIG. 1.—Average length in centimetres of one and two-year-old trout before and after fertilisation. (Dotted = Before. Cross Hatched = After Fertilisation).

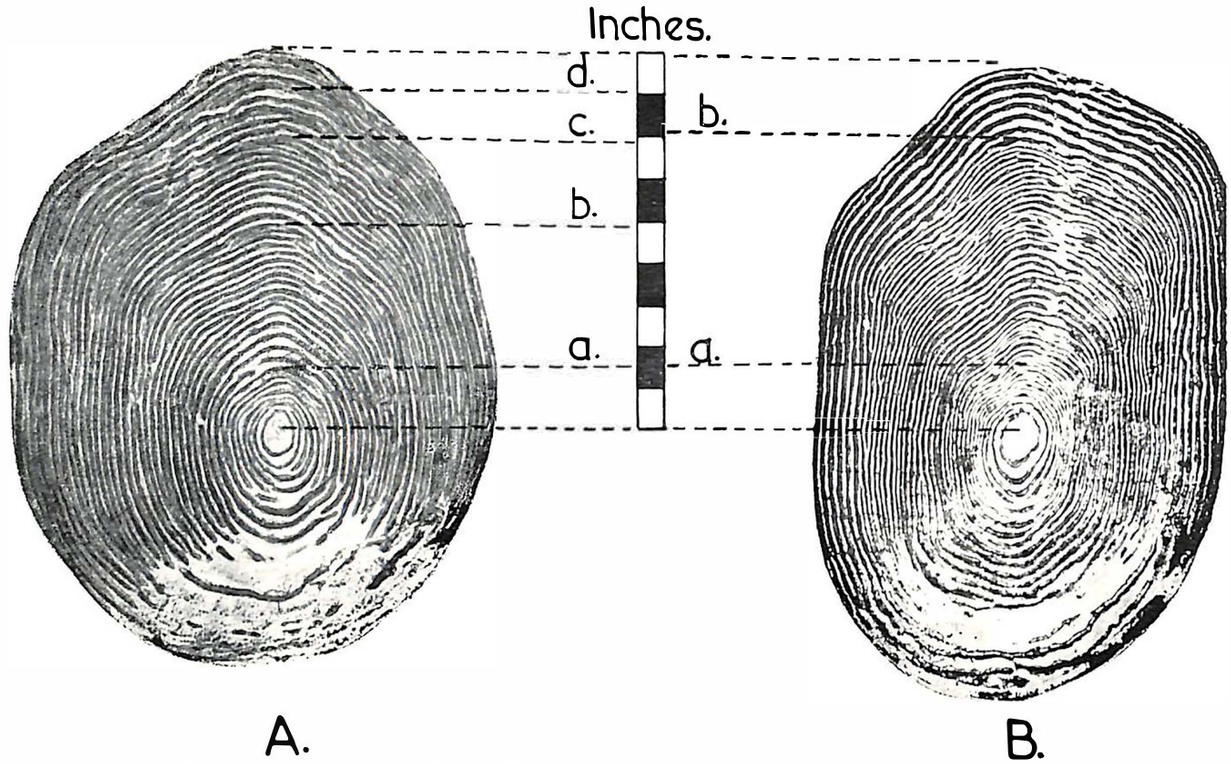

FIG. 2.—Microphotographs of two Brown Trout Scales.

A—From Trout 9 inches in length taken on 3/7/'51, age 4+years.
B—From Trout of same length taken on 31/5/'53, during the second year of fertilisation, age 2+years.

a—Length at the end of First Winter.
b—Length at the end of Second Winter.
c—Length at the end of Third Winter.
d—Length at the end of Fourth Winter.

grew very rapidly. This phenomenal growth was indicated by the great width of the individual annuli on the scales. The growth was similar to that of a sea trout. Rapid growth was again reflected in the scales for the third year of fertilisation. This rapid growth is illustrated in Fig. 2. Similar growth rings were observed in the scales of trout which were transferred from Lough Feagh, Co. Mayo, to the rich feeding grounds of Lough Conn (unpublished data). Gross (1947) also noted that the improvement of the growth of unmarked plaice and flounder was reflected in a striking change of pattern caused by the widening of the rings in the otoliths.

(b) *Weight.*—The average weights of all fish taken in the 1950 and 1954 collection are given in Table 5. The percentage increase is also included in the table. This increase in weight is highly significant, more especially since the 1954 sample of trout from Kinlooey Lough and Lough Aunemlagh was net caught. The net used had an inch mesh (knot to knot) and as a result small fish that could not be caught normally by rod and line are included in the calculations. All fish from the other two lakes were caught by rod and line. The greatest increase in weight is found in Barfinnihy Lough (238%) and the least in Lough Ananima ($33\frac{1}{3}$%).

The average calculated weights (using the formula $K = \frac{10^6 W}{L^3 \times 427}$ Nall (1930)) where W = weight in pounds and L = length in inches., of the pre-fertilisation and post-fertilisation samples of fish in the different age groups are given in Table 6. The percentage increase is also included. In Kinlooey Lough the most significant increase in weight occurs in the first year, whereas the other three lakes show a greater increase in the second and third year. Gross (1947) found that the plaice of Lough Craiglin made a growth in weight in one year after fertilisation equivalent to two years growth in normal fishing ground. The calculated weight increments of the pre-fertilisation and post-fertilisation samples of the four lakes are represented graphically in Figure 3.

(c) *Condition Co-efficient.*—Correlated with the increase in weight which is shown in Table 6 there is a corresponding increase in condition co-efficient (K) or length/weight relationship. The average value for K and its value in the different year groups is given in Table 7. With the exception of the four-year-old fish in Lough Ananima, of which there was a paucity, the increase is significant for each year class. The increase in K in the other age groups in Lough Ananima is significant. Gross (1947) got a very satisfactory increase in the condition of unmarked plaice and flounder in Lough Craiglin after fertilisation.

(d) *Stomach Analysis.*—The data collected for food study of the pre-fertilisation and post-fertilisation samples of trout cannot be considered as conclusive since they were taken at

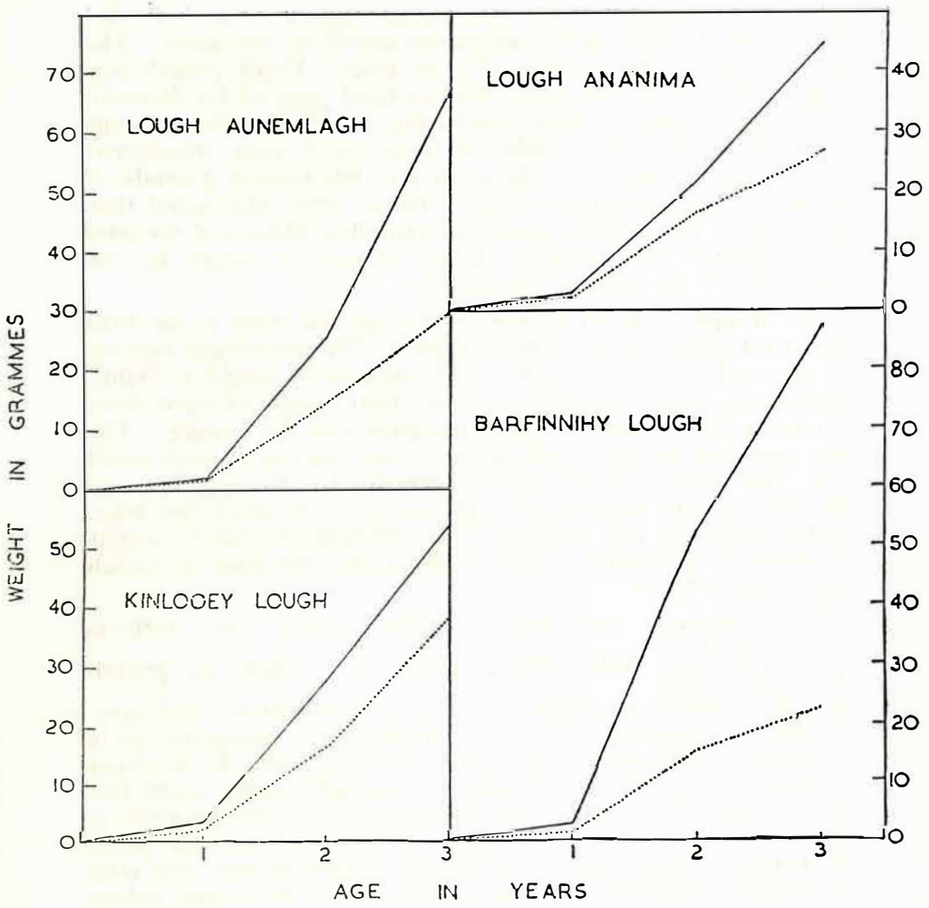

FIG. 3.—Average weight increments made during the first three years of life before and after fertilisation. (Dotted line = before, and full line = after fertilisation).

different periods of the year in Kinlooey Lough and Lough Aunemlagh. Southern (1935) has shown that the food of trout is subject to seasonal variation.

Both the pre-fertilisation and post-fertilisation samples in Lough Aunemlagh showed chironomid larvae and pupae to be the dominant food. Terrestrial insects are next in importance in the stomachs of pre-fertilisation trout, whereas crustacea in particular *Ascellus sp.*, predominated in the stomachs of trout after fertilisation. Kinlooey Lough shows that crustacea predominated in the post-fertilisation analysis, whereas terrestrial insects were dominant in the pre-fertilisation samples.

The results of the analysis of stomach contents from Lough Ananima indicated that there was an increase in the food supply in this lake. The 1951 results show that 42 per cent. of the fish had empty stomachs, whereas in 1955 only 3·5 per cent. were recorded with empty stomachs. The two samples from Lough Ananima were taken in August. The stomach contents of the two years' sampling is given in Table 8 for Kinlooey Lough, Lough Aunemlagh and Lough Ananima. There was no post-fertilisation data of stomach contents for Barfinnihy Lough trout since it was the local anglers collected the scale material.

Discussion.

The data presented in this report gives the biological effects of fertilisation on the fish population in four Irish lakes. The preliminary examination conducted prior to fertilisation revealed the lakes as very unproductive, a condition more or less typical of all the acid bog areas of Ireland. The growth rate in brown trout was slow and the condition of the fish was poor. A faunistic survey of the shoreline showed the fauna to be meagre and even absent in many areas. Observations also indicated poor light penetration. Fertilisation resulted in an increase in the growth rates and condition of the fish. This increase was significant in Barfinnihy Lough, but in the other three lakes the increase obtained was so small that it is doubtful if the expenditure (of about £4 per acre) would be justified. Much more experimental work is required before any conclusion can be drawn from fertilisation of dystrophic lakes. Fertilisation of moderately deep oligotrophic lakes seems to be well worth while from the results obtained from Barfinnihy Lough, but how long the effects of fertilisation will last is a point which has to be investigated further.

The use of ground limestone alone did not give any worthwhile results in Lough Ananima, although Hasler *et al* (1951) got satisfactory results by using ground limestone alone in certain brown water bog lakes. There was an increase in transparency and an increase in oxygen content at cooler strata in the lakes studied by him. He does not mention any increase in fish yield, but concludes that the more favourable conditions brought about by alkalisation should result in an increase in fish yield.

Summary.

1. The hydrographic data of the four lakes selected in the experimental fertilisation scheme are given (Table 1).

2. Material consisting of scales, lengths, weights and stomach contents of a sample of fish was taken from the lakes before and after fertilisation.

3. An analysis of the pre and post-fertilisation samples of water shows an increase in what are considered to be the most important elements in fish culture (Table 2).

4. An increase in the calculated length of the different age groups is indicated for Kinlooey Lough, Lough Aunemlagh and Barfinnihy Lough. Lough Ananima does not show any increase (Table 3).

5. There is a significant increase in the length of the one and two year old fish as a result of fertilisation (Fig. 1, Table 4).

6. There is an increase in the actual average weight of the post-fertilisation trout from all lakes (Table 5).

7. Fertilisation resulted in an increase in the calculated weight of the fish in the different age groups (Table 6). There is also an increase in the weight increments (Fig. 3).

8. There is an increase in the condition co-efficient (K) or the length/weight relationship (Table 7).

9. Stomach analysis showed a variation in diet between the pre-fertilisation and post-fertilisation samples, but this variation may be seasonal in the case of Kinlooey Lough and Lough Aunemlagh.

TABLE 1.—Area in statute acres and average and maximum depth in feet of the four lakes.

	Kinlooey Lough	Lough Aunemlagh	Lough Ananima	Barfinnihy Lough
Area	30	15	59	30
Average depth	15	17	10	30
Maximum depth	30	30	20	50

TABLE 2.—Chemical analyses of lake waters before and after fertilisation (results in parts per million).

	Phosphates	Calcium	Potassium	Ph
KINLOOEY LOUGH :				
Pre-fertilisation	nil	2·8	trace	6·8
Post-fertilisation	0·8	4·4	1·9	7·3
LOUGH AUNEMLAGH :				
Pre-fertilisation	nil	8·7	trace	6·4
Post-fertilisation	0·4	17·7	2·3	7·0
LOUGH ANANIMA :				
Pre-fertilisation	nil	trace	trace	6·0
Post-fertilisation	nil	18·7	1·1	6·4
BARFINNIHY LOUGH :				
Pre-fertilisation	nil	7·4	trace	6·4
Post-fertilisation	1·2	21·0	2·5	6·8

TABLE 3.—Average calculated lengths in cm. of the different age groups.

	1st Year	2nd Year	3rd Year	4th Year
(*a*) KINLOOEY LOUGH :				
Pre-fertilisation ...	6·3	13·6	18·5	—
Post-fertilisation ...	7·1	15·0	20·4	—
(*b*) LOUGH AUNEMLAGH :				
Pre-fertilisation ...	6·0	12·2	17·8	20·6
Post-fertilisation ...	5·6	13·6	20·7	23·6
(*c*) LOUGH ANANIMA :				
Pre-fertilisation ...	5·6	13·2	16·8	21·6
Post-fertilisation ...	5·8	13·2	17·8	21·6
(*d*) BARFINNIHY LOUGH :				
Pre-fertilisation ...	5·6	12·2	15·7	—
Post-fertilisation ...	6·4	17·3	23·1	26·7

TABLE 4.—Calculated growth rate in cm. of the one and two year olds prior to and after fertilisation.

	1st Year	2nd Year
(*a*) KINLOOEY LOUGH :		
Pre-fertilisation	6·6	14·2
Post-fertilisation	8·5	16·3
% Increase	28·0	14·0
(*b*) LOUGH AUNEMLAGH :		
Pre-fertilisation	6·6	12·2
Post-fertilisation	7·3	15·8
% Increase	10·6	29·5
(*c*) BARFINNIHY LOUGH :		
Pre-fertilisation	7·1	13·2
Post-fertilisation	14·2	20·1
% Increase	100·0	52·3

TABLE 5.—Average weight in grams of the pre-fertilisation and post-fertilisation sample.

	Pre-fertilisation	Post-fertilisation	% Increase
KINLOOEY LOUGH ...	73·7	90·7	43
LOUGH AUNEMLAGH ...	59·4	99·2	66
LOUGH ANANIMA ...	68·0	90·7	33⅓
BARFINNIHY LOUGH ...	39·7	150·3	238

TABLE 6.—Average calculated weight in grams of the different age groups.

	1st Year	2nd Year	3rd Year	4th Year
(*a*) KINLOOEY LOUGH :				
Pre-fertilisation ...	2·3	18·4	58·1	—
Post-fertilisation ...	3·9	31·2	85·0	—
% Increase	69·0	37·6	46·0	—
(*b*) LOUGH AUNEMLAGH :				
Pre-fertilisation ...	1·6	15·9	45·4	70·9
Post-fertilisation ...	1·7	26·9	93·5	116·1
% Increase	6·2	68·0	100·0	63·7
(*c*) LOUGH ANANIMA :				
Pre-fertilisation ...	2·3	18·9	45·4	—
Post-fertilisation ...	2·6	24·1	68·0	—
% Increase	13·0	27·5	49·7	—
(*d*) BARFINNIHY LOUGH :				
Pre-fertilisation ...	1·4	16·7	39·7	—
Post-fertilisation ...	2·8	53·9	141·0	170·0
% Increase	100·0	322·0	255·0	—

TABLE 7.—Condition co-efficient of trout taken prior to and after fertilisation.

	1st Year	2nd Year	3rd Year	4th Year	Average K
(*a*) KINLOOEY LOUGH :					
Pre-fertilisation ...	0·77	0·70	0·79	—	0·72
Post-fertilisation ...	0·91	0·89	0·86	—	0·88
(*b*) LOUGH AUNEMLAGH :					
Pre-fertilisation ...	0·72	0·74	0·70	0·73	0·72
Post-fertilisation ...	0·84	0·93	0·89	0·88	0·88
(*c*) LOUGH ANANIMA :					
Pre-fertilisation ...	1·12	0·87	0·84	0·88	0·87
Post-fertilisation ...	1·03	1·04	1·04	0·84	1·03
(*d*) BARFINNIHY LOUGH :					
Pre-fertilisation ...	0·66	0·79	0·78	—	0·77
Post-fertilisation ...	0·94	0·88	0·89	0·76*	0·89

*One fish,

TABLE 8.—Stomach analyses expressed as a percentage of the number of fish examined.

FOOD GROUPS	Kinlooey Lough		Lough Aunemlagh		Lough Ananima	
Mollusca	11	14	7	27	3	12
Crustacea: Asellus ...	8	31	33	36	—	—
Crustacea: Gammarus ...	4	4	2	12	—	—
Crustacea: Cladocera ...	50	36	5	16	—	24
Chironomidae	49	29	47	55	3	21
Tipulidae	8	—	5	16	—	—
Trichoptera (caddis) ...	11	10	14	—	2	19
Diptera	—	—	—	—	—	26
Zygoptera	—	7	2	—	—	14
Hemiptera	4	3	—	8	9	33
Coleoptera	—	3	14	8	1	5
Terrestrial insects ...	50	6	33	10	6	2
Hydracarina	34	—	2	10	—	—
Fish remains	4	3	—	—	—	—
Stomach empty	—	—	—	—	42	4

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References.

Ball, Robert C. (1948): "A summary of experiments in Michigan lakes on the elimination of fish populations with rotenone, 1934–1942." *Trans. Am. Fish. Soc.* Vol. 75 (1945), pp. 139–146. (1950): "Fertilisation of natural lakes in Michigan." *Trans. Am. Fish. Soc.* Vol. 78, 1948, pp. 145–155.

Ball, Robert C., and Tanner, Howard A. (1951): "The biological effects of fertilizers on a warm water lake. *Tech. Bull.* 223, *Michigan State College Agr. Exp. Sta.*, pp. 1–32.

Barrett, Paul H. (1952): "Relationships between Alkalinity and Absorption and regeneration of added Phosphorus in fertilized trout lakes". *Trans. Am. Fish.* Vol. 82 (1952), pp. 78–89.

Demoll, R. (1925): "Teichdungung" *Handb.d. Binnfischerei Mitteleuropas* 4, pp. 53–160.

Gross, F. (1947): "An Experiment in Marine Fish Cultivation. V. Fish Growth in a Fertilized Sea Loch (Loch Craiglin)". *Proc. Roy. Soc. Edin.* B.63 Pt. 1 (No. 5), pp. 56–95.

Hasler, Arthur D. and Einsele Wilhel, G. (1948): "Fertilization for increasing Productivity of Natural Inland Waters". *Trans. 13th N. Am. Wildlife Conf.*, pp. 527–555.

Hasler, Arthur D.; Brynildson, O. M. and Helm, William T. (1951): "Improving Conditions for Fish in Brown Water Bog Lakes by Alkalization". *The Journal of Wild Life Management*, Vol. 15, No. 4, Oct., 1951, pp. 347–352.

Juday, C.; Schloemer, C. L. (1938): "Effects of fertilizers on plankton production and growth of fish in a Wisconsin Lake". *Progr. Fish. Cult.* Vol. 40, pp. 24–27.

Macan, T. T. Mortimer C., and Worthington, E. B. (1942): "The Production of Freshwater Fish for Food". *Sci. Pub.* No. 6. Freshwater Biological Association of the British Empire (1942), pp. 2–33.

Mortimer, H. and Hickling, C. F. (1954): "Fertilizers in Fishponds". Colonial Office *Fishery Publication* No. 5, pp. 1–152.

Nall, G. H.: "The Life of the Sea Trout".

Neess, J. (1946): "Development and Status of Pond Fertilization in Central Europe". *Trans. Am. Fish. Soc.*, Vol. 76, pp. 335–354. 1.

Ohle, W. (1938a): Teichwortschaftliche Kalkkontrolle und die ph-SBV-Tasche. Z. *Fisch*, 36 pp. 185–191.

Reinecker, P. (1936): "Vorsicht vor Atzkalk in Winter". *Fischztg. Neudamm*, 39. pp. 1–10.

Smith, M. W. (1947): "Experiments on Pond Fertilization". *Bull.* 264, *Agr. Exp. Sta. of the Alabama Polytechnic Institute*—(1948): "Preliminary observations upon the Fertilization of Crecy Lake, New Brunswick". *Trans. Am. Fish. Soc.* Vol. 75 (1945), pp. 165–173—(1954): "Planting Hatchery Stocks of Speckled Trout in Improved Waters". *The Canadian Fish Culturist* No. 16, pp. 1–5.

Southern, R. (1935): "The Food and Growth of Brown Trout from Lough Derg and the River Shannon". *Proc. Roy. Irish Acad.* Vol. XXII., pp. 87–151.

Wiesner, E. R. (1936): "Die kunstliche Dungung in der Teichwirtschast". *Fachpr. Tschechoslowakei*, p. 262.

Wunder, W. (1949): *Fortschrittliche Karpfenteichwirtschaft.* (Progressive Pond-Culture of carp.) E. Schewitzerbast' sche Verlagsbuchhandlung, Erwin Nagele, Stuttgart, 1949. p. 386.

B.1815.A19501.A.3.550.5/58.A.T.&Co.,Ltd. G.3.